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MODERN IMPULSE TURBINE WHEELS

Methods of Connecting and Regulating this Type of Prime Mover

High-pressure impulse turbine wheels have been in use for many years in many power plants and have given excellent service, particularly in California and throughout the West, and in Switzerland, Italy and France, where turbines in hydro-electric plants are often required to work under very high heads. The impulse wheel is used mostly for high falls where the water can be projected onto the buckets of the wheel in one or several jets of small area. Usually there is but a single

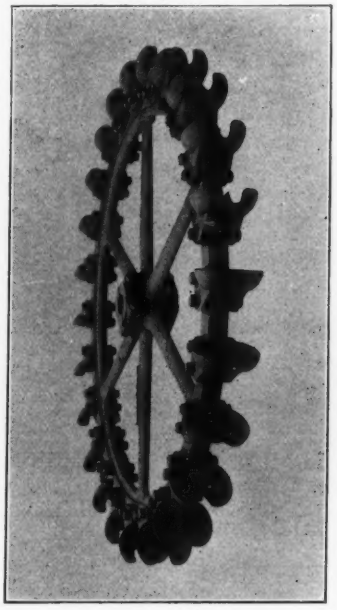


Fig. 1

jet but as it has been found that the area of the jet should not exceed certain limits, it is considered necessary in the case of large wheels to use two or more nozzles. Sometimes it is found necessary to use two wheels side by side on one shaft in order to obtain high speed with wheels of small diameter or in order to obtain high power for operating a large electrical generator. Under certain conditions, the two or more impulse wheels are placed in the same casing and mounted on the same shaft, driving the alternator or direct-current machine, while in other cases two or more impulse wheels in separate cases are directly connected to the dynamo.

With impulse turbine wheels the water enters radially at the outer periphery, in some cases spoon-shaped buckets being used which are open at the side so as not to restrain the jet of water, which leaves the buckets inwardly and outwardly as well as sideways. Various manufacturers in Europe and America have different forms of buckets; in some cases the entire wheel with buckets consists of a single casting, in others, the buckets are fastened to a steel web, or cast-iron or steel wheel with radial arms. The accompanying illustration, Fig. 1, shows the impulse turbine wheel of Abner Doble type, of California; while figure 2 shows various jets from the Doble nozzle. At the Butte Co. Electric Power and Lighting Co.'s plant there is in operation a pair of 58-inch Pelton wheels

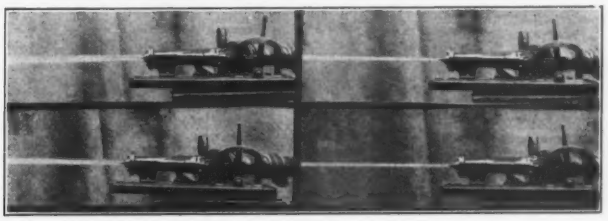


Fig. 2

working under a head of 590 feet and in many places in the West impulse turbines are driving electrical generators under very high heads. As an illustration of impulse turbines operating under comparatively low head it may be stated that three water-wheels of this character are connected together on the same shaft to drive a single 300 kilowatt two-phase alternating-current generator at Fitchburg, Mass., as shown in Fig. 3.

The impulse wheels are always enclosed in casings and with few exceptions, caused by local conditions, are mounted upon horizontal shafts, and when driving electrical generators, either of the direct-current types of small size or of alternators of as large a capacity as 750 kilowatts or greater, the dynamos are directly connected to the impulse turbine wheel shaft, the speeds being usually sufficiently high and so designed as to

meet the requirements of the electrical generator without other methods of connection. The impulse wheel of Escher, Wyss & Co., of Zurich, Switzerland, is shown in the accompanying drawing, Fig. 4, together with the arrangement of the Swiss governor employed. The quantity of water supplied to wheel is regulated by means of a hinged tongue, fitted into the rectangular nozzle, which can be moved by hand or automatically, and enlarges or contracts the free cross section of the nozzle, as required. It is claimed that one important advantage of this system of regulation is that the power produced is almost exactly proportional to the amount of water used, which is not the case with many other forms of regulation which act by means of throttling. It may be noted that this saving of water is of especially great value in case of high-pressure installations, where the water is frequently drawn from a reservoir and great economy in its use is essential.

At the Kubel electric power plant there are in operation a number of impulse wheels of the type shown in Fig. 4, four being double wheels of 500 horse power each, operating at a speed of 375 revolutions per minute, while two are double-impulse wheels of 1200 horse power each, operating at a speed of 300 revolutions per minute. The net fall is about 250 feet and the length of pipe nearly a thousand feet, the diameter of the pipe line being about five feet. Each of these wheels has a hydraulic governor and pressure regulator driving the electrical generators with but little variation in speed. Although these are impulse wheels it is stated that they work with about 20 feet of suction head, which is made possible by a special arrangement which admits enough air to the draft-tube to prevent the water level from rising as high as the wheel.

The accompanying illustration, Fig. 5, shows the construction of the Tutthill water wheel and governor, as constructed by the Oakland Iron Works, of Oakland, Cal., which have been in use for some time for driving high-tension alternators with water power at moderate heads. There are two Pelton wheels within the casing and the power supplied can be regulated by gate valves or by the governor.

An instance of multiple-impulse wheels of the Pelton type driving an arc light generator in an American electric station is shown in Fig. 6. At this plant six Pelton wheels are connected on the same shaft in a single casing directly coupled to the arc light machine, the water being supplied at moderate pressure from a single main and subdivided into six pipes to the six nozzles at the turbine, the governor automatically cutting out of service one or more of the jets to maintain the proper speed.

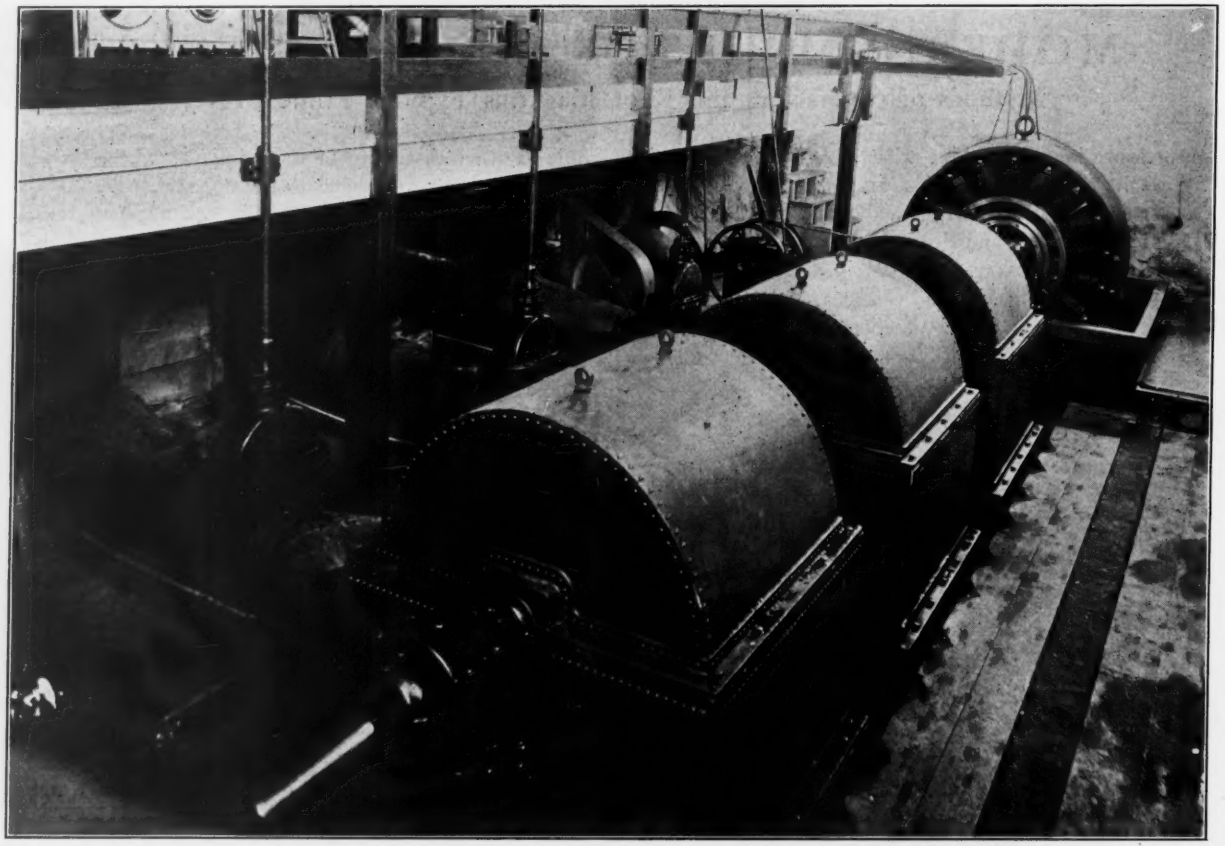


Fig. 3. 300 K. W. 2-phase Generator operated by Three Impulse Turbines at Fitchburg, Mass.

Many hydro-electric stations in Switzerland are operated by impulse turbine wheels, as these types seem to be particularly well adapted for the mountainous regions of the Alps, where high-pressure water powers prevail. Special attention has been paid to regulating these water-wheels, very close regulation being obtained by the governors of the water-wheels at the Boudry monophase electric station in Switzerland and at the Unsine Geneva plant, where two 200 horse power Piccard turbines operating under a head of 320 feet are employed, each being directly coupled to two six-pole

direct-current generators of 100 horse power each, as shown in Fig. 7.

The accompanying illustration, Fig. 8, shows a new type

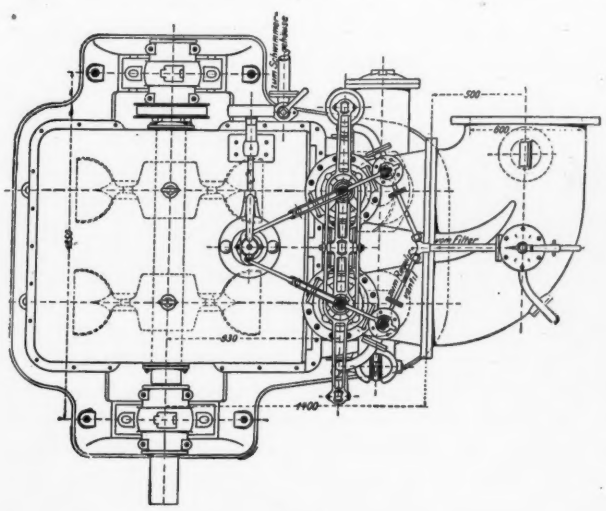


Fig. 4

of English multiple nozzle Pelton water-wheel of 50 Brake horse power. This wheel is said to have given 85 per cent. efficiency on brake tests. The wheel shown in the illustration operates at a speed of 135 revolutions per minute, using 700 cubic feet of water per minute under a 50-foot head when developing the power above-mentioned. It was constructed for driving compressors and drop-stamps in connection with the prospecting plant at a gold mine at Rio. The water passes through 3 nozzles and valves controlled by hand wheels, after entering by a branch 2 feet in diameter. The nozzles are 3⅝ inches in diameter and are constructed of phosphor bronze to prevent corrosion, the same metal being used for the valves, bearings and seatings. A steel plate 4 feet in diameter and ½-inch in thickness is used for the wheel itself, this plate being mounted on a 3-inch shaft. On the periphery of this plate are fastened about 18 buckets, widened at the sides, to allow the

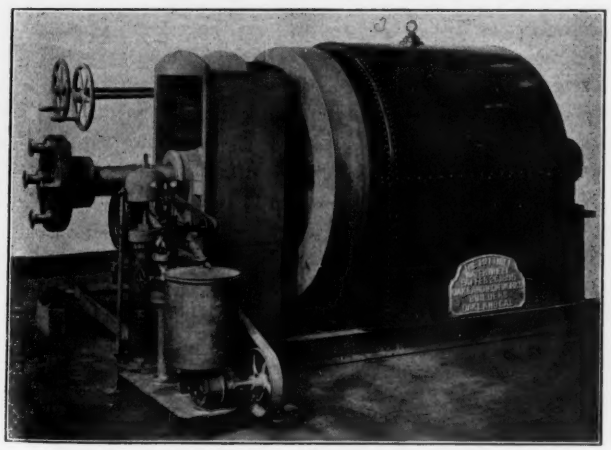


Fig. 5

water to spread and leave the wheel freely when its velocity has been given up. Steel plates, ¼-inch thick are used for the casing, riveted on a framing of angles by ½-inch rivets at 3-inch pitch, all joints being caulked absolutely water-tight. In order that the nozzles and buckets may be easily removed, the top half of the casing is so arranged that it may be lifted

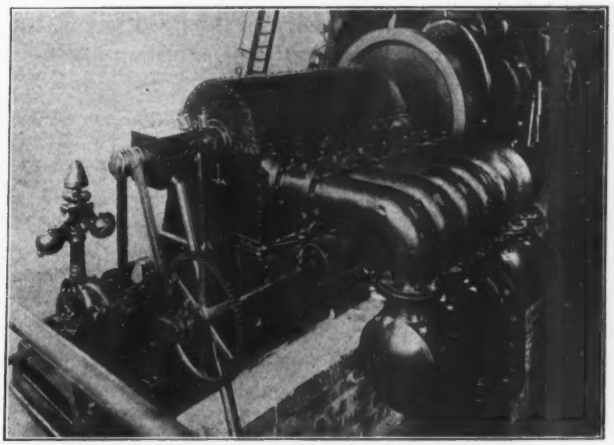


Fig 6

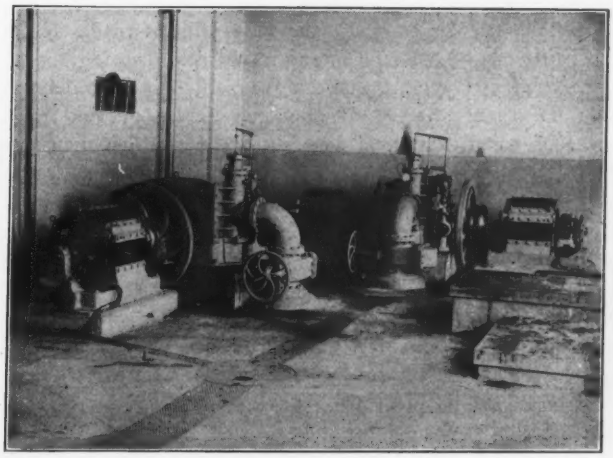


Fig. 7

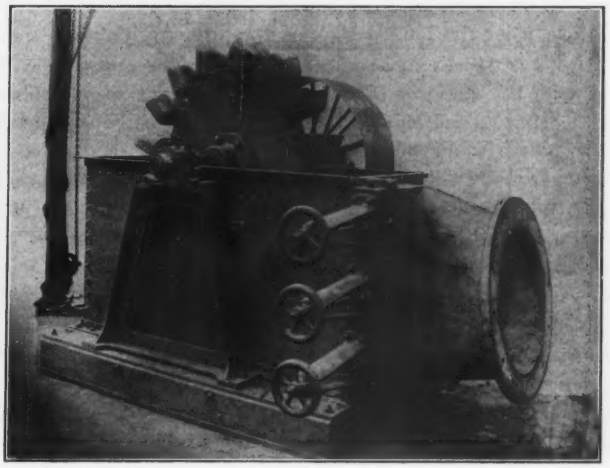


Fig 8

off and half of one of the lower sides is also so constructed as to be easily removed. There is no governor shown in illustration, but when one is utilized, the wheel is guaranteed

to have a minimum drop of speed of 3 per cent. from full load to no load, with an efficiency of not less than 75 per cent.

With the governor employed, a plate of metal is hinged at the ends of one of the nozzles, deflecting more or less of the water from this nozzle, thus governing the speed very closely. The governor is of the centrifugal type, actuating the device by means of worm gearing and bevel wheels. If the speed is too high, one of the bevel wheels is operated, while if the speed is too low, the other bevel wheel comes into play, giving excellent regulation when electrical generators are directly coupled to the wheeel. It is also arranged so that the deflecting plate may also be operated by hand, if desired.

MAKING BLUE PRINTS

By Jacob Glogan.

One of the important sections in mechanical drawing is that of Blue Printing. To obtain a blue print you must have what is known as a tracing of the drawing. To get the tracing, tracing paper or tracing cloth is used. This tracing paper is an almost transparent cloth which is placed over the original drawing and then the tracing is made. There are two surfaces on tracing cloth, namely: the smooth or glazed side and the dull side. The dull side is the side which you place against the original drawing.

After the tracing is ready, the blue print is made. Blue print paper can be obtained in any mechanical drawing supply store, but if you wish to make it yourself, it is made as follows: Dissolve 1 ounce of ammonia citrate of iron in 6 ounces of water, and in a separate bottle dissolve the same quantity of potassium ferri-cyanide in 6 ounces of water. Keep these solutions separate and in a dark place or the solutions will be of no use. To prepare the paper, mix the same amount of each solution and with a sponge or soft cloth spread it evenly over the surface. Let the paper remain in a horizontal position until the chemical has set on the surface, then hang the paper up to dry. When drying, see that no light strikes the paper or it will lose some of its value.

To make a blue print from the tracing, place the tracing with ink side down against the glass surface of the printing frame, then take the blue print paper and place the sensitized side down on the tracing, on the top of the paper, place a felt cushion (which generally accompanies a good printing frame) and then place the hinged back of the printing frame on top. After this is done, expose to the sunlight. The exposure will vary with the strength of the sunlight. To make good blue prints, being guided only by the exposed edge of the sensitized paper, take a small test piece of the same paper and a piece of tracing cloth with a few lines drawn on it, and expose that to the sunlight the same time that you exposed the large print. By having a dish of water at your side, you may tear off at different times pieces of the test blue print and wash it in the water. If the test piece shows up in a deep blue color and clear white lines, then it is time to take the big print out. After the print is taken out, it should be washed in cold water for ten minutes and then should be hung up to dry. Corrections can be made on the print with an ordinary writing or ruling pen and a solution of washing soda, caustic potash, strong ammonia, or any other alkali.

To obtain sharp lines on a blue print, all lines on the tracing should be heavier than on ordinary drawing paper and a sharp inking pen should be used.

By using the following solutions, prints having blue lines on a white ground or just the opposite of a blue print may be obtained: 3 ounces of common salts, 8 ounces of ferric chloride, 3¼ ounces of tartaric acid, 25 ounces of acacia, 100 ounces of water. Dissolve the acacia in half the water and dissolve the other acids in the rest of the water, then mix the two together. The solution is applied with a brush to a well-rolled paper in a subdued light. The paper should be dried as quickly as possible on account of the acid eating into the pores. When the paper is dry, it is ready for use. One or two minutes are sufficient in strong sunlight and a considerable longer time in a dull light.

To develop the prints, it must be washed, after leaving the frame, in a very weak solution of potassium ferricyanide. None of this solution should touch the back of the print. Developing takes but a minute or two. If the background of the print is of a blue color, the print was not exposed long enough and if the background shows a pale blue color, then the print has been exposed too long.

When the development is complete, the print is washed in clean water for two or three minutes and then placed in the following solution for ten minutes: 3 ounces of sulphuric acid, 8 ounces of hydrochloric acid, and 100 ounces of water. In this solution all the iron salts not turned into blue compound will disappear. After this is done, the print is washed in water and then allowed to dry.

One of the important uses of blue prints is its use in the shop to the mechanic or engineer. The best advice to be given to them is to take the blue print and mount it on a pasteboard back, but if it is required to keep the prints in first-class shape, mount them on sheet-iron backs, and then apply a coat of varnish over each side so as to make it waterproof.

To make drawings from the prints, the blue prints may be inked over with waterproof ink and when thoroughly dry washed with a solution of oxalate of potash; treated thus, the ink lines will remain and the blue ground will fade, leaving the background white and appear like an original drawing.

Erasing on tracing cloth, in case of mistakes or errors, should be done with an ink eraser or a sharp, round erasing knife. The surface of the tracing cloth must be made smooth in those places where erasing had been done. This is done by rubbing the cloth with soapstone or powdered pumice stone applied with the fingers.

The term circular mills, which is often used for designating the size of large wires and cables, is obtained by squaring the diameter in mills, a mill being one-thousandth of an inch. To reduce circular mills to square inches, divide by 1,000,000 and multiply by 0.7854.

REINFORCING RINGS FOR STEAM BOILERS

Rules Applicable to Manhole and Handhole Openings

By Chas. J. Mason.

In answer to the call of W. E. B., as contained in letter, pages 27 and 28, February issue of The Practical Engineer, the following set of rules are submitted, relating to the subject of reinforcing rings for manhole and handhole doors in steam boilers.

The purpose of reinforcing rings is to strengthen the plate at the manhole or handhole opening to the extent of the amount by which the plate has been weakened in cutting out the piece. Sometimes only one ring is used and then again two may be used, one inside and the other outside of the plate to which they are secured. The thickness of a single ring may be from 1.25 to 1.5 times the thickness of the shell plate in which the hole is cut. When two rings are used, the thickness of each ring may be equal to the thickness of the shell.

Reinforcing rings must be securely riveted to the shell and the rivets must be so proportioned and their number must be such that the combined resistance to shearing will be at least equal to the resistance of the reinforcing rings to a tensile stress. The rings, of course, should be made of the same material as the shell of the boiler.

The formula by which the *width* of a single ring is found, when *single* riveted, is as follows:

$$(1) \qquad w = \frac{lt'}{2t} + d$$

in which w = the required width; t = the thickness of the ring; t′ = thickness of the shell plate; d = diameter of the rivets when driven; l = length of the opening in the shell.

The formula for finding the width of *single* rings, but *double* diveted, is as follows, the value of the letters remaining the same:

$$(2) \qquad w = \frac{lt'}{2t} + 2d$$

When *two* rings are used, either with *single* or *double* rivets, the formulas are like this:

$$(3) \qquad w = \frac{lt'}{4t} + d \text{ for } \textit{single} \text{ rivets}$$

$$(4) \qquad w = \frac{lt'}{4t} + 2d \text{ for } \textit{double} \text{ riveted rings}$$

One illustration will suffice to illustrate the operation of these four formulas. A manhole opening in a certain boiler is 11 inches by 15 inches, the 11 inches being measured in the direction of the length of the boiler; the shell plate is ½-inch thick. If a single riveted reinforcing ring ⅝-inch thick is to be used, how wide should it be, if the rivets are one inch driven size? Substituting the numerals for the letters in formula (1), we have the following statement:

$$w = \frac{11 \times \frac{1}{2}}{2 \times \frac{5}{8}} + 1 = 5.4 \text{ inches wide}$$

or, using decimals instead of fractions, the formula becomes

$$w = \frac{11 \times 0.5}{2 \times 0.625} + 1 = 5.4 \text{ inches}$$

Suppose, instead of finding the width, the width was known and the thickness of the ring was required, the formula (1) becomes

$$(5) \qquad t = \frac{lt'}{(w - d) \times 2}$$

where t is the unknown quantity. Using the same figures as in example above, the formula becomes

$$t = \frac{11 \times 0.5}{(5.4 - 1) \times 2} = .625''$$

These methods also apply where two rings are used and for single and double rivets, it only being required to substitute the proper figures in formulas (1), (2), (3) and (4).

When calculating for the minimum number of rivets, the net section of rings is used. For single riveting, the net section is found by subtracting the driven diameter of the rivet from the width of the ring and multiplying the remainder by the thickness of the ring. For double riveting, subtract twice the driven diameter of the rivet from the width of the ring and multiply the remainder by the thickness of the ring.

The nominal diameter of the rivets for a single reinforcing may be made equal to the thickness of the shell plate plus $^{7}/_{16}$-inch; and when two reinforcing rings are used, the diameter may be equal to the thickness of the shell plate plus $^{5}/_{16}$-inch.

Having settled on the diameter of the rivets to be used in any given case, the number may be found from the following formula:

$$(6) \qquad n = \frac{4Ta}{Sd^2 \times .7854} \text{ for } \textit{single} \text{ rings}$$

$$(7) \qquad n = \frac{8Ta}{1.85 \times Sd^2 \times .7854} \text{ for } \textit{double} \text{ rings}$$

in which n = number of rivets; T = the tensile strength of the ring per square inch section; a = net section of ring; S = shearing strength of rivets per square inch section; 4 is a constant for single-rivet calculations; 8 is a constant for double-rivet calculations; 1.85 is a constant for the rivets in *double* shear when *two* rings are used; $d^2 \times .7854$ are well-known factors to find the area of one rivet. S, the shearing stress, is usually taken as 38,000 pounds per square inch section.

When it appears that the number of rivets, as found from the formulas (6) and (7), is too small, so that they will be too widely spaced, a smaller diameter may be figured on and the rule applied as before. By a little experimenting, the exact size and number of rivets can be found.

Manhole openings which are flanged do not require any further reinforcing with rings.

Power Station Wrecked By Fly-Wheel Explosion

Greasy Governor Belt Caused Runaway Engine

There are many persons who do not believe in such things as luck or fate, but there are at least three persons, who were at or near the Chester Traction Company's Southwestern power house when the fly-wheel burst, that are sure of it, and they are also sure that luck or fate was kind to them. The accident referred to took place at 4.25 on the afternoon of March 2d, and as a result of the bursting of the fly-wheel, one-half of the power house was completely wrecked, three men had hairbreadth escapes, one engine was almost entirely demolished and the station was put out of business for several days.

The station where the accident happened is located at Penrose Ferry Bridge, near the Schuylkill River, and the power generated is used for operating trolley cars between Philadelphia and Chester, a distance of about 14 miles. The station was built about ten years ago and constantly increasing loads

Fig. 1. The Power House immediately after the Explosion

Fig. 2. The Power House a few days after the Explosion

were being demanded from it, owing to the increased traffic along the lines which the power house supplied.

The station is equipped with four Keeler boilers of 125 horse power each, which supplied steam to two Hamilton Corliss engines, manufactured by the Hooven, Owens and Rentschler Co., of Hamilton, O. The engines have cylinders 20 inches in diameter and 36-inch stroke and were operated condensing. The engines are of the belted type, having fly-wheels 15 feet in diameter with a 30-inch face. Under the usual conditions, the engines were run at 110 pounds steam pressure with 24-inch vacuum, at a normal speed of 105 revolutions per minute.

On the afternoon of the accident, the engine, whose fly-wheel exploded, had been carrying the load for about 10 minutes, it having just been thrown on the line, and the other engine was being slowed down preparatory to stopping for the night. While the engineer was shutting down this engine, he noticed the incandescent lights around the place brighten up and upon looking at the other engine he saw at once that it was running away.

In quick time he was at the throttle of the runaway engine, but he noticed that while the engine was running very much above its normal speed, the governor would not rise and he immediately realized that the governor belt was slipping. Before, however, he could give the throttle several turns, the armature of the generator to which the engine was belted burnt out, sending out fireworks in all directions, and this caused the engine to take another jump in its speed. The engineer, still struggling at the throttle, which was in line with the fly-wheel, next saw the pulley on the generator go to pieces and at the same time the main fly-wheel burst, sending pieces above him, below him and around him, and although the roof also caved in, he escaped unscratched.

The fireman, who noticed from his lights in the fire-room that something was wrong, entered the engine room for the purpose of helping the engineer but as he approached the engine, the engineer, realizing the impending danger, told him to run for his life and just as he ran out of line of the fly-wheel it burst, and two several ton pieces of the wheel just grazed his heels.

When the fly-wheel burst, it sent pieces of spokes and rim in all directions in line with its plane of revolution. The power house immediately after the explosion had an opening in the roof and sides that looked as if a saw eight feet wide had cut a slot through it. One piece of the wheel was sent through the roof in a southerly direction and after going over the car barn, which is next to the power house, struck a tree and chewed out a large piece from it. Another piece, which must have just missed the engineer's head, struck the heavy brick wall dividing the power house from the car barn and knocked a hole through it about four feet long and two feet wide.

The force of the explosion was felt worse in the northerly direction. About 300 feet away two coal barges were lying in the river and by the looks of the boats and the surrounding wharf it must have rained iron. The captain of one of these

barges was seated in the cabin when one piece, evidently weighing several tons, struck the top of his cabin and cut a hole through it and the side of the vessel, it evidently just passing his head by a few inches. The heavy timbers were cut through as easily as if they had been cheese, the piece doing the damage having landed in the river after paying its short visit to the boat.

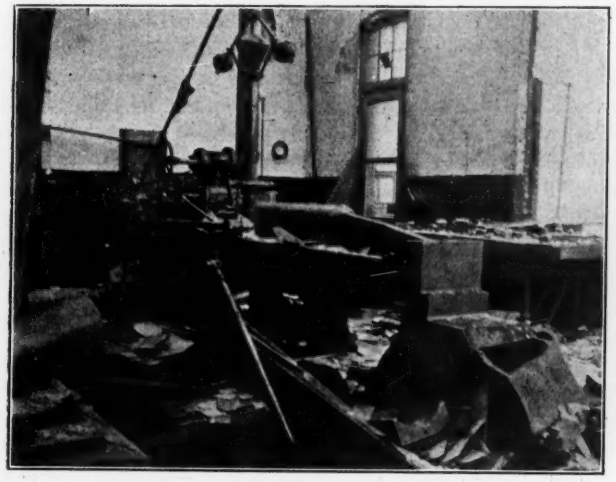


Fig. 3. Valve Gear Side of Wrecked Engine

The accident to the engine was caused by a greasy governor belt, which caused the governor to fail to act. A new belt had been ordered to take the place of the one that failed but it did not arrive in time. The fly-wheel which did the damage was constructed with eight elliptical spokes, the wheel being in two halves. Every spoke was broken off close to the hub, which remained intact on the main shaft. The accident caused the outboard pedestal and the top of the main bearing to be broken off, thus allowing the main shaft to jump out of its bearings, so that the main shaft, crank pin, connecting-rod, crosshead and piston rod remained in their proper sequence, the only damage, besides a twisted connected rod, being to the piston rod, which broke where it entered the piston.

Fig. 5. A View of the Belted Generator showing Broken Pulley and Main Bearing of Engine

The generator was not damaged except for the broken pulley and the burned-out armature. It is a Westinghouse six-pole generator, operating at 550 volts with a full load current of 360 amperes. The pulley which broke on this dynamo was 34 inches in diameter by 30 inches face. Notwithstanding the force of the explosion, the proximity of the flying pieces and the falling debris, not one light of the cluster on the dynamo was injured.

Fig. 4. Front Side of Wrecked Engine

Referring to the accompanying photographs, Fig. 1 shows the power house a short time after the explosion. The clean-cut opening in the roof and side of the building shows the force of the explosion. Fig. 2 shows the power house after the front wall was torn down and the temporary wooden partition put in to protect the remaining portion of the power house from the elements. Fig. 3 shows the valve gear side of the engine and was taken from spot where the fly-wheel stood. As will be noticed, the valve gear was not injured, the eccentric strap having broken off when the fly-wheel went to pieces. Fig. 4 shows the front side of the engine. The crosshead and piston rod can be seen partly covered by the slating which

Fig. 6. Showing Fallen Roof Rafter. The greatest force of the Explosion was in this direction

was used on the roof. Fig. 5 shows a view of the generator which was belted to the engine. The manner in which the generator pulley was broken at the hub can be seen. In the foreground will be noticed the outboard bearing of the engine, which was snapped off and thrown where it is now seen. Fig. 6 shows the roof rafter in its original position after the explosion. Had it fallen all the way to the ground, the engineer who was standing under it would undoubtedly have been killed.

Care of Brasses.

By E. C. Taylor.

About every engineer that is running an engine has his own method of fixing over the crosshead and crank pin brasses. Take the case of a pair of new brasses, for instance. Brass boxes always need fitting to the bore or pin. They should be scraped to a good bearing using a little red lead and a good scraper and lots of patience until they fit. Sometimes when brasses do not quite fit the entire length of the pin, as is very commonly the case, it is customary to tighten the key until the rod can just be moved by hand. This is an approximate adjustment, and if the pin heats, the key is slackened back a little; or if it pounds, it is set up.

As a matter of fact, there is nothing known definitely of the fit of the brasses to the pin, and while looseness may be detected by pounding, it also causes a larger amount of wear by

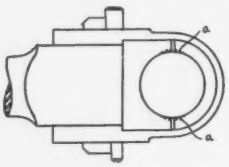


Fig. 1

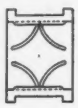


Fig. 2

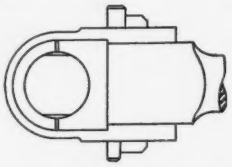


Fig. 3

the pounding of the boxes out of shape. If, however, the brasses are a fit to begin with and yet do not butt together, it is customary to drive the key in until the brasses bind the pin and then slack back, giving the necessary amount. What that amount should be cannot be said because it varies with the taper of the key and the force with which it is driven home. As a result, then, the operation is left to the judgment or in other words to guess-work of men, many of which are not experienced in the operation. While, under any circumstances, the actual fit is not known, a very good way is to insert a piece of lead wire of small diameter between the brasses. The key is then driven home and then slackened back until the lead wire is just freed. It is then estimated that this adjustment is the correct one but yet there is no actual certainty of the fitting this way.

One engineer that the writer ran across had solid brass boxes, the fit of which he obtained by keying up tight and then pouring on a stream of water until it wore itself in. This seemed to me to be a very crude way. Sometimes the brasses will be a good fit to the pin before putting on the strap, and yet when the strap is put on and the gib is put in and the key driven home, the box is extremely tight on the pin, which will undoubtedly cause heating. Cases like these are often caused by the pounding on the pin. This causes the brasses to be peened out and stretched. This also causes them to spring the strap and when the brasses are taken out and fitted to the pin when they are replaced and keyed up, the strap is drawn down by the gib and causes the brasses to be pinched together. This can be remedied by taking the brasses and refitting them to the strap. They should also be eased away a little as shown at *a*, Fig. 1. This also does away with any inclination to pinch as stated.

Another little wrinkle that is not practiced by all engineers lies in the fact that the inside edge of the brasses on the top of the pin, if it is a horizontal engine, should be chamfered away but yet not quite up to each side of the brasses. This leaves a nice little reservoir, as it were, for the retention of the oil, as shown in Fig. 2. The writer advocates the use of grease as preferable to oil. Of course, there are some places and conditions that favor oil but as a general rule, nine out of every ten engines fitted with good automatic grease cups and a good quality of grease will give first-class service with a great deal less trouble and attention.

Solid brass boxes are a good deal worse to run than Babbitt lined and will heat up a good deal quicker but yet when once worked into good condition will outlast the other kind by far. I have seen brass boxes heat up to such a degree that had they been Babbitt lined, the Babbitt would have been out on the floor. And yet, these same boxes after being cooled off and scraped, ran first class. Babbitt-lined boxes will not heat up so quickly as brass, as the Babbitt, being a softer metal, causes it to wear itself to conditions more quickly, and yet they must be watched closely, as they will not stand so much heat as the brass boxes before being ruined, and as they wear away more quickly, make more frequent adjustments necessary. Then, again, conditions in some cases are entirely different. For instance, take the difference between the crank and the crosshead. The crank is continually working in a circle, thus wearing the crank pin all around, but the crosshead is entirely different. There the boxes are working in an oscillating motion. This causes the pin to wear oval and after a time, as the pin becomes more worn through the action of the boxes being keyed up, there is a tendency to grip the side of the pin, thus making a tremendous bind, which is liable to shear off the dutchman on the pin and allow it to turn on the crosshead. If this continues long, the pin is ruined, as the hole in the crosshead becomes too large, and so a new pin is necessary.

Some engineers file a flat on the top of the crosshead pin, as shown in Fig. 3, to obviate wearing oval. Now, while this may help the trouble, to my mind it is entirely wrong. When a horizontal engine is running, the crosshead, in addition to the thrust at each stroke, has to carry the weight of the connection rod and thus should be round and not flat. It seems to me that a better way would be to take the pin out if possible and get it turned up. If this is not possible, it can be filed round, taking a little time and patience, and polished up with a piece of emery-cloth. By so doing, the pin may be got into fairly good condition. Good oil channels should be cut in, to connect with the chamfered edge, as before stated. These should be carried pretty well down into the box but not clear to the edge or the oil or grease will run out at the sides instead of staying in the boxes where it belongs.

To successfully run any kind of bearings, an engineer must have a good nose, a cool head, and common sense.

In calculating the horse power of tubular boilers, 12 to 15 square feet of heating surface are considered as equivalent to one nominal horse power.

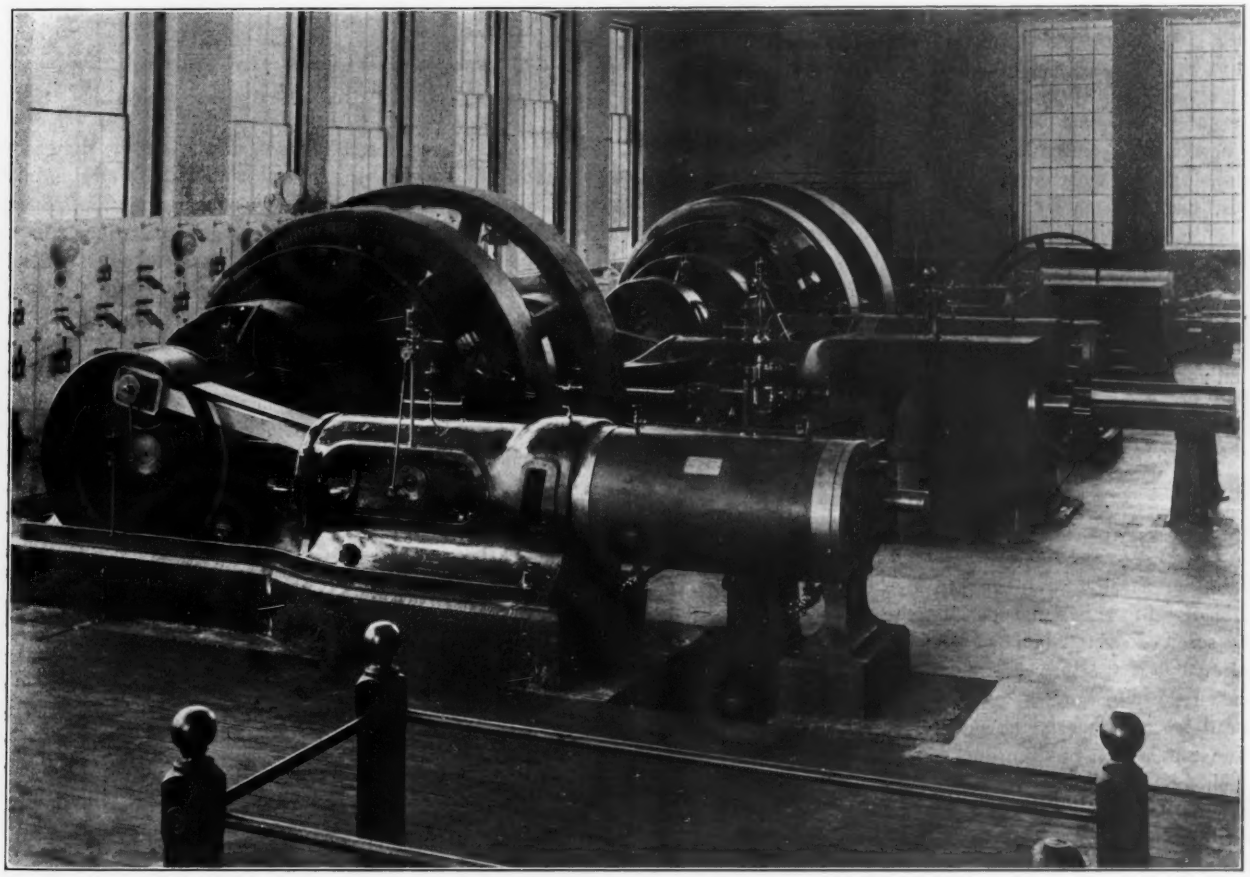
AMERICAN RAILWAY POWER PLANTS

By Frank C. Perkins.

The accompanying illustration shows a thoroughly up-to-date electric plant as installed in the power plant at the Collinwood shops, near Cleveland, Ohio, of the Lake Shore and Michigan Southern Railway Co.

In all modern railway shops electric power is extensively used, not only for operating electric cranes, motor driven tools, including lathes, planers, drills and other machines, but also for lighting the buildings and yards. This engine room illustrates well the equipment of such an electric generating plant where a moderate amount of power is required.

There are installed in this room two 400 kilowatt direct-current electric generators of the Crocker-Wheeler type, each directly connected to a non-condensing cross-compound engine, constructed at Salem, O., by the Buckeye Engine Co.



Engine Room of the Collinwood Shops near Cleveland, Ohio

These two 18¾ and 32½ x 33″ compound engines operate under a steam pressure of 150 pounds and a speed of 130 revolutions per minute. They have each a rated capacity of 650 horse power, and an economical range of 520 to 750 horse power, while the ultimate capacity of each of these units is 860 horse power.

In this engine room there is also installed a 10 x 21″ simple engine, direct connected to a 75 kilowatt Crocker-Wheeler, direct-current generator. This engine also operates under a steam pressure of 150 pounds per square inch but has a speed of 200 revolutions per minute. The rating of this engine is 125 horse power, with an economical range of from 100 to 155 horse power, while the ultimate capacity is 180 horse power.

Another typical power station for railway service operating suburban electric trains, and of the general construction extensively utilized throughout the United States for electric railway service is that noted in the accompanying illustration on front cover. This shows the interior of the power house of the Dayton and Muncie electric railway, at Winchester, Ind. The engines in this plant were also constructed at Salem, O., and are similarly designed to those described above. To each of these cross-compound engines is directly connected a 500 kilowatt alternating-current generator, built by the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa. The main engines are 21″ and 42″ by 48″, operating at a speed of 95 revolutions per minute, and working under a steam pressure of 150 pounds per square inch. The alternators are supplied by current for exciting their field coils by two small units, each of which consists of a 30 kilowatt Westinghouse direct-current dynamo, directly coupled to a simple engine having cylinders

7¾" in diameter, with a 12" stroke. These exciter engines operate at a speed of 300 revolutions per minute, with a steam pressure of 150 pounds per square inch. This station is provided with an overhead traveling crane, and with motor generators and switchboards as indicated at the right and in the background of the accompanying illustration, Fig. 2.

While many prominent engineers believe that the steam turbine and the high-power gas engine are rapidly entering the field of the reciprocating steam engine, there are an equal or greater number of eminent engineers who hold that the up-to-date reciprocating steam engine equipment of the general design shown in these two engine rooms, will be extensively used for years to come if they are ever entirely superseded by more modern forms of motive power. The reciprocating steam engine of the cross-compound and triple-expansion types, both of vertical and horizontal construction, have reached a wonderful state of development and perfection, and are thoroughly reliable in every way. The high-power gas engines, as well as the steam turbine, have undoubtedly made great headway during the past three or four years, and have been developed wonderfully during that time. With the perfecting of details of mechanical construction and design, undoubtedly these forms of prime movers will be utilized more and more in the future, to advantage.

There is every reason to believe, however, that the field of electric power generation is so wide as to find a place for each of these forms of engine, in which it has many points of advantage over the others on account of the local conditions and the many factors to be considered for the service required of it.

FLANGED PIPE JOINTS

Methods Used to Prevent Leakage and Give Maximum Strength

The constantly-increasing growth of the size of the power house, together with the increased pressures carried on steam pipes, have demanded that the greatest care be exercised when designing the steam mains which transmit the energy from the boiler to the engine. This particularly applies to the manner of support and to the various styles of flange joints used.

The flange joint as usually made consists of two smooth-faced companion flanges into which the pipe is screwed. The

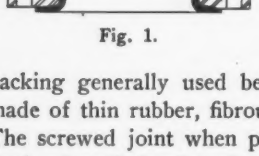


Fig. 1.

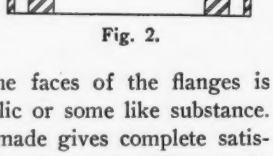


Fig. 2.

packing generally used between the faces of the flanges is made of thin rubber, fibrous, metallic or some like substance. The screwed joint when properly made gives complete satisfaction but if the threads are improperly cut, it will not only weaken the pipe but will probably cause a leaky joint. If the thread is cut properly, however, it will not weaken the pipe because it is always strengthened by the flange or fitting into which the pipe is screwed, and the many tests which have been made prove that fact.

In making flanged joints for high pressures, the flange and pipe should always be assembled at the shop before shipment. When assembled in the shop, the flanges are screwed up by power on a long taper thread cut to standard until the end of the pipe projects through the flange. When this is done, the pipe should be so screwed into the flange that no part of the thread is exposed at the shoulder, which would otherwise form a weak point in the pipe line. If the threads are cut clean, both on the pipe and in the flange, a tight screwed joint will result. The pipe should then be placed in a machine and the ends turned off flush with the face of the flange and usually it is also better to take a light cut off the flange also to insure its face being perfectly square with the pipe.

When flanges are put on in this manner it is generally recommended that other material besides cast-iron should be used for the flanges, for the reason that when the flanges are screwed on by powerful machinery it may cause strains in the flanges and when the additional strains of expansion, contraction, internal pressure and pressure caused by the bolts are added, they are likely to give way, so that ferrosteel, malleable iron and cast-steel are used for particular work.

There are various other methods used for making the joint between the flange and the pipe but they are only to be found in special places. One of these is the lap joint, which is shown in Fig. 1. The pipe is a sliding fit in the flange and the pipe is turned over the flange. The face of the flange is generally tapered slightly to conform with the curve in the pipe which gives a flat bearing surface and retains the full thickness of pipe on the lapped-over portion. Another joint used is the weld joint, shown in Fig. 2. It is made by welding a wrought-steel flange to the pipe. This makes one homogeneous mass of the joint and consequently there can be no possibility of a leak between the flange and pipe.

Another style of joint used for special purposes is shown in Fig. 3 and is known as the shrunk and riveted joint. These joints are made by first forcing the pipe perfectly round and then boring out the flange to a shrinking fit. The flange is then put in the fire, brought to a red heat and placed over the end of the pipe and allowed to partially cool, when the end of the pipe is beaded over into a chamfer on the face of the flange, in order to form a perfectly true alignment with the pipe

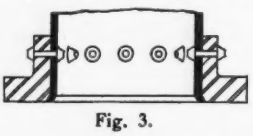


Fig. 3.

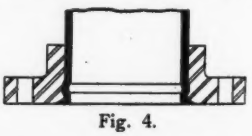


Fig. 4.

and also to form a firm bearing for the gasket. The gasket in these cases should be made so that it will cover the ends of the pipe, thus preventing the steam or fluid from coming into contact with the joint between the pipe and flange and any possibility of leaks. They are made in the single or double riveted style. In some cases the joint is only shrunk on and the pipe beaded over, the rivets being omitted. A special form of joint used for pressures under 50 pounds is shown in Fig.

4. It is known as the rolled joint and is constructed by rolling the pipe into a corrugation in the flange. During the operation, the end of the pipe is upset and rolled back into a chamfer on the face of the flange. This joint is adaptable where the pipe used is too light to thread, as the full thickness of the metal is retained.

Besides the flanges with smooth faces, there are various forms which are used to insure tightness in a direction perpendicular to the line of the pipe. One of these is shown in Fig. 5. The face of the flange is made corrugated by scoring it with a series of concentric rings about $^1/_{64}$-inch deep. When this kind of flange is used, the gaskets should not be less than $\frac{1}{8}$-inch thick. Another form of joint used is shown in

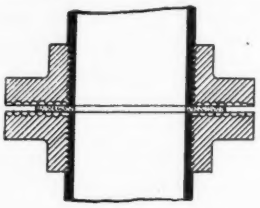


Fig. 5.

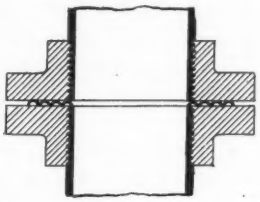


Fig. 6.

Fig. 6. Here the regular smooth-face flange is used, but a corrugated copper gasket is inserted which acts very similar to corrugated faces shown in Fig. 5.

A style of facing which is usually specified for pump mains in mines is shown in Fig. 7. It is known as the male and female faced flange. The male face projects from $^3/_{16}$ to $\frac{1}{4}$ of an inch according to the size of the pipe and extends out from the inner circle of the pipe to about half-way to the bolt holes. The female face is recessed from $\frac{1}{8}$ to $^3/_{16}$ of an inch in depth, according to the size. The gasket is placed in the recess and as the ends of the pipe bear on the gasket, it forms a good joint, preventing the steam, water or air from reaching the joint between the pipe and the flange. The gasket cannot blow out and if the width of the recess is designed properly, there will be enough bearing surface to prevent it from being squeezed out by the pressure. The principal objection to this style of facing is the difficulty of opening the line in case it is necessary to renew a gasket or replace a fitting or valve.

An arrangement shown in Fig. 8 is sometimes used, but as the projections and recesses do not extend to the inner circle of the pipe and are very narrow, they not only have a tendency

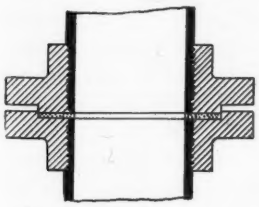


Fig. 7.

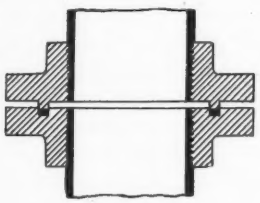


Fig. 8.

to squeeze out the packing but they allow the contents of the pipe to come into contact with joint between the flange and pipe.

Flanges which have smooth raised faces are used extensively in some parts of this country and are frequently specified for high pressure work. As shown in Fig. 9, the faces are raised $^1/_{32}$-inch or $^1/_{16}$-inch, inside of the bolt holes, and the projecting faces turned off smooth. With this form of joint, copper or thin rubber gaskets are generally used. When it is not desirable to use packing of any kind in the joint, this same form of joint is used and the faces are ground in place by the use of a special grinding or face plate, emery and oil being used for the grinding mixture.

Flanges are sometimes made with recesses cut in the hubs on the back of the flanges for heavy work, as shown in Fig. 10. These recesses are generally about $\frac{1}{4}$-inch wide at the top, $^5/_{16}$-inch wide at the bottom and $\frac{1}{2}$-inch deep. These recesses are filled with some form of metal after the flange is screwed on the pipe and caulked in firmly to prevent the flanges from leaking where they join the pipe. When the flanges are used on cold water lines, the recesses are filled with lead and when used on steam lines, the recesses are filled with soft copper, both of which are caulked in against the threads.

The Manufacture of Peat.

At the present time, when there is so much interest centred in the outcome of the negotiations between the coal miners and operators, it might be interesting to know of the progress recently made in the manufacture of fuel from peat, near Fond du Lac, Wisconsin, by the Lamartine Peat, Light and Power Company.

This Company began their investigations in the spring of 1905 and at the present time are manufacturing peat successfully. The peat is first removed from a submerged bog by machinery, a steel cage 18 by 36 inches and 8 feet long being forced down into the bog, so that one ton can be removed every 60 to 90 seconds. The peat is next treated by

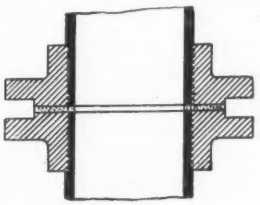


Fig. 9.

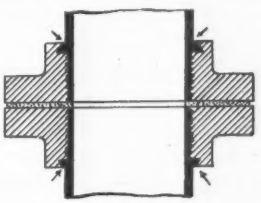


Fig. 10.

being put in dies so as to eliminate the water, one machine being capable of turning out 120 tons of crude peat in 10 hours.

The peat as it comes from the machines is placed on racks, under open sheds, for natural drying. The product, containing 10,781 British Thermal Units, has been sold during the past fall for $6.00 a ton in the city of Fond du Lac. It is said that this fuel can be manufactured and sold at the plant for $1.20 per ton.

The power transmitted by belting depends directly on the speed and the amount of pull exercised. The greater the speed, the more power is transmitted for the same pull on the belt, or the greater the speed the less pull is required for the same power. Wire rope can be safely run at a considerably higher speed than belting and is much stronger in proportion to its size and weight. It does not often replace belting in ordinary work for the reason that owing to its small size, it does not grip ordinary pulleys anywhere nearly in proportion to its strength. Therefore, to best take advantage of its ability to transmit large powers, the rope speed must be high and the pulleys must be unusually large in diameter to give sufficient surface of contact.

METHODS OF TESTING ELECTRIC MOTORS

Electrical and Prony Brake Methods for Finding Efficiency

When testing an electric motor for efficiency, there are two methods which may be used: one which is strictly electrical, and one which is a combination of mechanical and electrical methods. Before touching upon these methods employed, however, it might be well to see what are the variables which affect the efficiency of a motor. To begin with, there is the self-evident friction load of the motor, which includes the friction

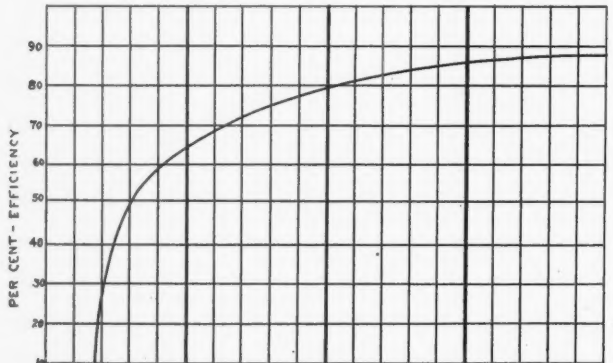


Fig. 1

of the bearings, the friction of the brushes and the windage loss due to the revolving armatures. Then there is the hysteresis and Eddy current loss in the iron discs which make up the body of the armature; there is the loss due to the heating of the armature conductors, due to the current passing through them and finally there is the loss due to heating of the field coils.

The efficiency of a motor depends directly upon these losses. The greater they are, the less the amount of useful work is given out in proportion to power absorbed and the less therefore the efficiency. Some of the above-mentioned losses are constant, so that it is very evident that a motor which is lightly loaded is very much less efficient than one run at or near its rated capacity. If a curve be plotted between the per cent. of rated load and the efficiency of an average well-designed shunt motor, the curve of efficiency will take the form as shown in Fig. 1. From the curve it will be noticed that while the efficiency of the motor is about 65 per cent. at one-quarter load, it is 80 per cent. at half-load and 86 per cent. at three-quarters load and 88 per cent. at full load.

When testing a motor, there are two electrical instruments which are necessary: the voltmeter and the ammeter, and for commercial purposes these will be sufficient if the voltmeter and ammeter can be read to a fraction of a volt and ampere. If the voltmeter and ammeter have only high reading scales, then some other instruments or methods must be used for finding the armature and field coil resistance, when testing the motor by the electrical method.

Assuming, then, that the voltmeter and ammeter can be read to a fair degree of accuracy, the first step that is necessary, when testing the motor according to the electrical method, is to find the resistance of the armature and fields. To find the resistance of the fields, the field terminals are disconnected from the armature terminals and should be connected as shown in Fig. 2. Before making this test, however, the amount of current passing through the field should be determined when the motor is running under load by placing the ammeter in series with field. This amount of current should be maintained when the test is being made for resistance and the readings should be taken when the field coils are warm, because the resistance of wire is greater when it is hot than when it is cold.

Referring to Fig. 2, FF are the field coils, A the ammeter, V, the voltmeter and R, the adjustable resistance. If the voltmeter reads 110 volts and the ammeter reads 1.5 amperes, then the resistance of the fields is equal to the volts divided by the amperes, or $110 \div 1.5 = 136.3$ Ohms. Since the number of amperes flowing through the field coils is low, the accuracy of the result is based upon how accurate the ammeter can be read.

In making the test for the resistance of the armature, care should be exercised that too great a current is not passed through the armature coils or they will be burnt out. The voltage should not exceed about 2.5 per cent. of that used by the motor. When the service mains are used for furnishing the current, there should be a resistance put in series to cut down the voltage to that amount. The arrangement of connections is shown in Fig. 3. A is the ammeter, which is con-

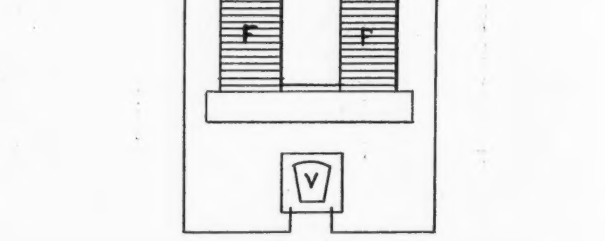


Fig 2

nected in series with the armature, R is the adjustable resistance and V is the voltmeter connected across the brushes of the armature. Suppose, then, the voltage is 2 volts and current passing through the armature coils 80 amperes, then the resistance will be $2 \div 80 = .025$ Ohms. In making the test for the armature resistance, care should be taken that the

brushes are set exactly on the commutator bars directly opposite each other.

Having found the resistance of the field and armature, the motor should be connected up and run with no load on it and the amount of current and voltage which it requires

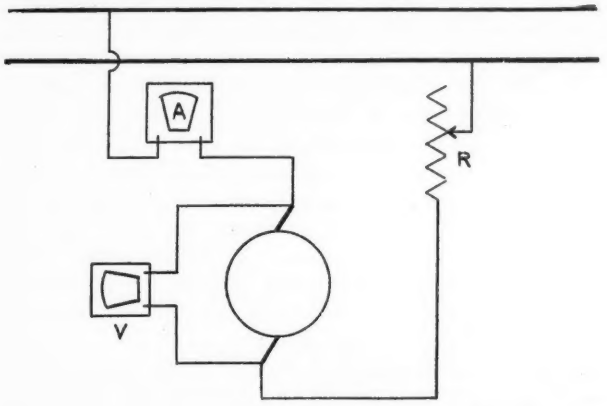


Fig. 3

found. Suppose that at 110 volts it requires 8.5 amperes to turn it at its normal speed, then $110 \times 8.5 = 935$ watts. This power represents the heat lost in the armature and field plus the losses which are considered as constant at all loads. These constant loads are those due to hysteresis, Eddy currents, windage and friction. They are equal to the no-load input minus the no-load armature and field losses. Suppose that 165 watts are lost in the field and 560 are lost in the armature, due to the no-load current, then $935 - (560 + 165) = 210$ watts constant loss at all loads.

Now throw the load on the motor and find the number of amperes and volts required to run the motor with that load at its normal speed. Suppose it takes 60 amperes at 110 volts, then $110 \times 60 = 6600$ watts is the amount of power put in the motor. Of the losses, 210 watts are constant in the armature and 165 watts are lost in the field. Since it is known that resistance of the armature is .025 Ohms, then $60 \times .025 = 1.5$ volts are absorbed by the armature, or $1.5 \times 80 = 120$ watts, which is the armature loss at the given load. Then, $210 + 165 + 120 = 495$ watts are absorbed in the motor, so that $6600 - 495 = 6105$ watts are available for useful work. Then, $6105 \div 6600 = 92.5$ per cent. efficiency.

If the above steps are understood and there are two voltmeters and two ammeters available, the process can be simplied by making the connections as shown in Fig. 4. Run the motor at no load, as before, and take readings of the voltmeter and ammeter in the armature circuit. If the resistance of the armature is known, the constant losses can be obtained by subtracting the C^2R losses in the armature from the total power. Then throw on the required load and read the instruments in the armature and field circuits. The product of the readings of the voltmeter and ammeter in the armature circuit added to the product of the readings of ammeter and voltmeter in the field circuit give the total power put in. The total losses are the constant losses and the losses due to heating of the armature and field coils. These latter can be obtained by multiplying the square of the current by the resistance of the coils, or if the drop of voltage is known, it can be multiplied by the current to get the power lost. In all cases, the machine at the time of no-load test should have the same temperature as it would have under the load for which the efficiency is being calculated.

In case a compound wound motor is being tested for efficiency, the same method applies, except that the resistance of the series coils must be known, and since they are in series with the armature, the armature current squared multiplied by the series field resistance gives the loss in those field coils. This loss must be added to the shunt field loss to get the efficiency. Unlike the shunt field loss which is practically constant for all loads, the series field loss varies proportionally with the load.

The best and most satisfactory method for the practical man and one which applies to all kinds and forms of motors is the mechanical-electrical method. The electrical input is measured by a voltmeter and ammeter and the mechanical output is measured by some form of dynamometer, usually of the kind known as the Prony brake. Then the efficiency is found by dividing the number of watts absorbed by the brake, by the number of watts put in the motor. There are many kinds of brake or absorption dynamometers that may be used for this test. A very simple one used for motors of small size is the strap brake, shown in Fig. 5. A piece of leather belting and two spring balances are all that is necessary except a form of turn-buckle which can be used for raising and lowering one of the balances to give the proper tension to the belt.

The formula for finding the amount of power absorbed by the dynamometer can be obtained from the formula:

$$\text{Watts absorbed} = \frac{6.28\ rV(P - P')}{33{,}000} \times 746$$

in which r = radius of pulley in feet.

V = number of revolutions per minute.

P = pull on one balance.

P′ = pull on other balance.

(P — P′) = difference in pounds.

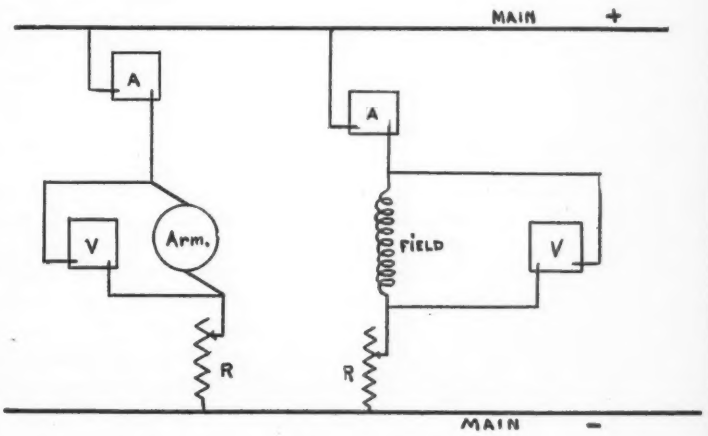


Fig. 4

The factor 33,000 is used to get the number of foot pounds absorbed into horse power and the factor 746 is used for getting the horse power into watts.

Fig. 6 shows a form of brake which is applicable to larger machines. It may be made, as shown, with wooden blocks or it may be made with a metal strip having spaced blocks on its under surface which rests against the wheel. In the place of

the spring balance, a platform scale may be used, the lever arm of the brake in that case being allowed to rest on a prop which in turn rests on a scale. The formula for the power absorbed is

$$\text{Watts} = \frac{6.28\ rVP}{33{,}000} \times 746$$

in which r = perpendicular distance from the centre of the pulley to the line of action of the scale, in feet.

V = number of revolutions per minute.

and P = the scale reading in pounds.

The value of P represents the value due to the turning of the pulley, so that the weight due to the brake should first be found and subtracted from the reading when the test is being made, or the brake can be poised so as to give a zero reading on the spring at no load.

One objection to the dynamometer method is that when large motors are tested, excessive heat is generated at the surface of the pulley. Some means are therefore necessary to carry the heat away. This is generally accomplished by flanging the inside of the brake wheel which forms a trough into which water is kept running. Centrifugal force throws the water against the internal circumference of the wheel and the hot water is removed either by a scoop or it may be allowed to evaporate.

When testing alternating current motors for efficiency, the dynamometer method should be used. The input of the motor should be determined by a wattmeter, and the ratio of the amount of watts absorbed by the brake, to the amount put in as read on the wattmeter will give the efficiency.

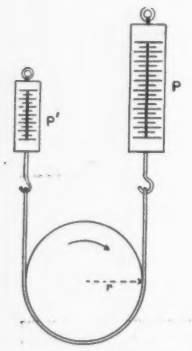


Fig. 5.

Fig. 6.

The readings of the ammeter and voltmeter are not sufficient to find the power absorbed on alternating current circuits on account of the power factor involved; the only exception to this is on circuits which have only a non-inductive load, such as a circuit containing incandescent lamps. A circuit of this kind has a unity power factor but a circuit like this is very rare in commercial practice. Any iron in the circuit will cause the current to lag behind the electro-motive force and any condenser effect in the circuit will cause the current to lead the electro-motive force.

To find the horse power which a shaft will transmit at a given speed, multiply the cube of the diameter by the revolutions per minute and divide by 70.

The Economy of Steam Turbines Compared with that of Reciprocating Engines.

In a recent issue of the Electrical World, Messrs. Stevens and Hobart have presented a series of interesting tests under the above title in which they take up the operation of the steam turbine under various conditions and its comparative qualities as related to the reciprocating engine. One of the points clearly brought out is the fallacy of the often-repeated statement that the reciprocating engine suffers severely in economy at light loads. In their comparison of the Parson turbine and the reciprocating engine they show clearly that assuming engines to be designed with reference to light load efficiency, their economy suffers little or not at all within the range of loads which they should in practice carry. In reference to full loads on both types of engines, the tests show that there is practically no difference of the steam consumption of both types.

With varying conditions, they have shown that under the conditions of a good vacuum and a low admission pressure, the steam turbine has the advantage over the reciprocating engine, but generally speaking, the highest steam economies have been obtained with reciprocating engines, though a point very little inferior has been reached by turbines working under favorable conditions. The employment of superheat has a considerably greater influence on the steam consumption of reciprocating engines than steam turbines. With vacuum, however, the reverse is the case, the economy of the turbine being more beneficially affected by a high vacuum than is the economy of the piston engine.

In forecasting the future of the reciprocating engine and the steam turbine, Messrs. Hobart and Stevens say: "The forecasting of the future as regards the steam engine, whether of the turbine or reciprocating type, is by no means an easy matter; but one thing is certain, that the relative positions of the two types, so far as concerns steam consumption, will in the future depend to a very large extent upon the amount to which their special characteristics are developed and utilized.

"The characteristic of the steam turbine, in being but slightly dependent upon the admission pressure, undoubtedly opens a path for the future, deviating from that along which the development of the piston engine will advance. The probable tendency in future designs of steam turbines, for large sizes, at any rate, will be to reduce the admission pressure and therefore the saturation temperature, thus permitting a greater range of superheat and removing to some extent the difficulties now encountered when dealing with high temperatures. In the case of the reciprocating engine, whose steam economy is so greatly affected by the admission pressure, the amount of superheat used is limited, on account of the very high temperatures to be dealt with, owing to the high admission pressure.

"There are certain obstacles in the way of the development of the steam turbine, consequent on the necessity of a more perfect condensing plant. The initial outlay would thus be considerably increased, though there doubtless will follow a considerable advancement in the design of condensers, both as regards efficiency and cost."

While the above conclusions have related only to the steam economy, there are many other factors which enter into practical consideration, such as the cost of oil and attendance,

steam consumption of the auxiliaries, the relative rates of depreciation of the two types and the amount of energy necessary to attain the various degrees of superheating attained. Since, however, there are very few trustworthy tests made in commercial working, the data correlated by Messrs. Stevens and Hobart may be looked upon as one step toward attaining that end.

The Many Uses of Refrigerating Machines.

Aside from the usefulness of refrigerating machines for producing cold for the preserving of stores and food products, there are many other applications to which it is put in other industries. For instance, the production of commercial chocolate requires during certain stages of its manufacture the use of artificial cold. The seed having been ground into a fine powder, is formed into a pasty mass and moulded. To produce the best results, the chocolate must be hardened at a certain temperature. This it was found could not be accomplished during the warmer months of the summer season without the use of refrigeration, so that there are now few, if any, factories for the production of chocolate that are without some means of artificial refrigeration.

In the manufacture of paraffin, refrigeration forms a necessary part of the production. After the wax has been thoroughly freed of impurities by successful washings, it is run into moulds of convenient sizes and there allowed to harden. Before the days of the manufacture of artificial cold, this took some time, but now it is a comparatively short operation. Another method is to keep the mixture of paraffin and oils in a long cylinder within which rotates a drum. The drum is hollow and by means of hollow trunions has current of cold brine circulated through it from a suitable refrigerating machine. The result is that oil adheres to the surface of the cylinder, being reduced to a plastic state by the cold. Scrapers afterward take off this accumulation and thus the separation of paraffin and oil is obtained. So common has refrigeration become in paraffin works that it is deemed an almost indispensable factor in the manufacture of this article of trade.

In the manufacture of artificial butter the ingredients are melted together and run into churns, where they are thoroughly agitated and mixed. Then the churns are opened and the contents drained out suddenly into open tanks containing an intensely cold body of water. The sudden change from warmth to a low temperature causes the particles of butter to crystallize and allows them to float on the surface while the water carries away all residue, which if allowed to remain would soon cause decomposition.

In the dynamite industry, refrigeration plays an important part as well as in the manufacture of nitro-glycerine. It is well known that it is quite difficult to explode dynamite when frozen, so that this is made a method of handling it with safety. Dynamite is nothing more than nitro-glycerine mixed with kieselguhr. The nitro-glycerine is prepared in small quantities by dropping glycerine into a mixture of strong nitric and sulphuric acids, the temperature being kept as low as possible by means of refrigerating apparatus. This not only aids the action but lessens the danger of the operation.

In the distillation of spirits, there is an opportunity for the use of refrigeration. The vapors, after being driven off from the retort or still, are carried into the condenser, where a circulation of cold water reduces the vapor to a liquid. The colder the condensing liquid, the more rapid the condensation, and thus the brine system again forms a convenient method of securing a sufficient degree of cold. Moreover, after the liquors are furnished and stored away, there must be a certain degree of coldness in the store-room or else there will be excessive loss by evaporation.

The manufacturers of photographic supplies find refrigeration beneficial to no small degree when making dry plates and films, inasmuch as it is the means of cooling the gelatinous surfaces which heat would cause to run or become streaky. Chemical works producing crystallized products find it very advantageous. Sugar refineries use it to freeze watery particles out of sugary juices. India rubber works cure and harden blocks or sheets of rubber by this means, enabling the sheets to be cut afterwards into any size and shape desirable with little trouble. Glue factories also use it to dry the gelatine.

One unique use of refrigeration is for freezing loose ground or ground containing much sand and water so that the sinking of wells, shafts or other similar engineering enterprises can be facilitated. In case the earth to be dug is so shifty as to follow up the boring tool and fill up the shaft as fast as it is sunk, the ground may be frozen until it becomes solid enough to withstand pressure. Such a method is a costly one; but it is said to have been carried out in more than one instance. The method employed is to place a circular row of pipes in the ground near which the excavation is to be made. These pipes are fitted so as to enable a brine circulation to be sent through them. This freezes the quicksand or silt and enables it to be removed like clinging earth. Having dug to the limit of the freezing, the brine pipes may again be sunk at a lower level and the digging continued. As fast as the shaft is dug, it would be necessary to put in a lining to hold the outer earth when it should thaw.

There is one application of refrigeration that far exceeds all of those mentioned and that is in breweries. By its use there is an improvement in the quality of the drink, complete control of the fermentation and cooling, and a consequent cheapening of the cost of manufacture.

The air cylinder of an air compressor should be lubricated with the best grade of mineral oil of light body and high flash test. It should not be of a coking nature, for if it is, it carbonizes on the inside surfaces of the air heads and valves and not only prevents the valves from acting properly but it frequently is the cause of accidents. The air cylinder requires but a small quantity of oil and after the machine has been running long enough for the cylinders to acquire smooth and polished surfaces, two or three drops per minute will be found a sufficient amount to keep the cylinder and its valves in satisfactory condition.

A short rule for finding the change required in the length of belt when one of the pulleys on which it runs is changed for one of different size, is as follows: Take three times the difference between the diameters of the pulleys and divide by two. The result will be the length of belt to cut out or put in.

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The Unfairness of It All.

When a man gets sick, he usually goes to a doctor and if he does not take the doctor's advice and grows worse, he is very likely to blame himself. The same thing applies to legal advice; the man in need of such advice will go to a lawyer and will generally adopt what his lawyer tells him to do in a legal way. When he is in need of engineering knowledge, he employs an engineer and when he does not take his engineer's advice and anything happens, should he not be to blame? But is that the case?

Take, for instance, the case where a fly-wheel explodes or the engine breaks down. In ninety-nine cases out of a hundred, it is because the proprietor will not allow the engineer to make the necessary repairs or will not heed his engineer's advice about the condition of the plant. In far too many manufacturing establishments, there is often a disproportionate amount of saving of the expense in the engine room compared with other departments. The engineer is often compelled to go short handed, he is often required to repair his machinery, compelling him to work overtime and Sunday, he is often denied the necessary equipment and new apparatus asked for, and as a result he knows that the plant is often not in a safe condition to run. Many engineers have resigned their positions owing to these conditions but there are often other circumstances which compel a man to remain.

In the event of an accident, it is usual with most large companies to discharge the man in charge, if he survives the accident, on the theory that it will better keep up the morale of the other employees even if the accident is the result of their own policy; or if there is an investigation, the engineer is often charged with carelessness even if he has warned his employers about the probability of the accident before it happened.

This is manifestly unfair and in many cases it is the owners of power plants that should be held for contributory negligence, rather than the man who must put up with conditions over which he has no control.

—o—

Little Drops of Knowledge.

One of the commonest excuses which we are all apt to make when we do not know anything is the plea that we have not had the time to look it up because our other duties have engrossed our time. Hundreds of men, young and old, have thus cheated themselves with the notion that they would do some desirable thing if they only had the time.

The truth is, however, that the busiest of us could find leisure for doing the extra things by utilizing the odd chinks and crevices of time and turning them from idle moments into drops of useful knowledge and self-improvement. It is not the man who is surrounded by a luxurious library with whole days of leisure on his hands who makes the most of his opportunities. It is rather the man who, whenever he gets the chance to get hold of a book, will, for the five or ten minutes' leisure that he may have, bathe in its intellectual riches and bring up facts that can never be loosened from his grasp.

In estimating the time which a man can give to self-improvement, it has been figured out that if the average man lives to be 70 years old, or for 25,500 days, he will have only about 4000 days left at his disposal for direct intellectual de-

velopment. Surely, then, in looking over the field of successful men, it can be truly said that it has been the little drops of knowledge with the added grains of sense that have made this country mighty and its engineering achievements so immense.

—o—

The World's Coal Supply.

While there are various pessimists who see in the comparatively near future, an exhaustion of the world's coal supply, there are also various optimists who cannot see anything but unlimited resources of the world's fuel supply for several thousand years at least.

One of the latest optimistic views on this subject is published in the *Stahl* and *Eisen,* a German publication devoted to the interests of the iron and steel industries. While it admits the possibility of England's coal deposits being exhausted in about 350 years, it regards the German supply as practically unlimited. Germany's available coal supply has been estimated to contain 280,000,000,000 tons, which at the present rate of consumption should last a couple of thousand of years. This amount, the above publication thinks, is much too little and that 415,000,000,000 tons is nearer the mark.

The total European deposits of coal, according to this authority, amount to approximately 700 thousand millions. The mines of North America are estimated to contain nearly as much, or 681,000,000,000 tons. But even this enormous wealth in fuel is reduced to insignificance by the potential coal supply of Asia. Siberia and the island of Saghalien contain vast deposits but the fuel riches of the whole world are dwarfed by the almost inestimable riches of China. The province of Shansi alone is estimated to contain 1,200,000,000,000 tons of coal.

While the above estimates, if correct, show that America and Europe need not worry for some time about fuel to keep them warm and for energy to keep the wheels of industry in motion, yet the time may come when John Chinaman may hold the key to the industrial situation.

This situation may arise in the year 4906, but at the present time the important problem is not so much how many tons there are yet to be burned but how to utilize the number of heat units in each pound of coal so as to get the maximum efficiency therefrom.

—o—

Does this Mean the Passing of the Piston?

Several engineers of a large interurban electric trolley Company in the East recently made a tour of a number of power houses where steam turbines were installed, for the purpose of investigating the relative merits and demerits of that class of prime mover, so that they could better recommend to their Company what type of prime mover it would be best to install in their chain of power houses, in the future.

The result of their investigation was anything but encouraging, especially as regards the amount of information they obtained. In many of the power houses visited, they learned little more than what their eyes beheld. There were several reasons for this. One was that most of the plants visited were public service corporations which do not believe in letting any more information radiate from their plants than necessary, owing to the effect it might have on their stock, and the other reason was that the operating engineer was instructed not to give any information to anybody, under penalty of discharge.

In four of the plants visited, however, some information was obtained as regards operation but in no case could they find any accurate data about economy and cost of operation. In one plant, a 500 kilowatt Curtis turbine was being replaced by another one, at the manufacturer's expense, because the first one did not come up to specifications and it also failed from constructive reasons.

In another plant where one 5000 kilowatt Curtis turbine was installed, it was found that while it worked fairly satisfactory at times, yet at others it was very hard to keep in synchronism and on one occasion it ran away. In still another plant, where four 5000 kilowatt Curtis turbines were installed, it was found that they were being used very little, the burden of the load always resting on the reciprocating engines installed in the same plant. In the fourth plant, where a number of Parsons turbines were installed, the turbines seem to work satisfactorily except for the noise, which was almost unbearable. This, however, the engineer in charge said would be overcome in the future by enclosure of the dynamo, which would cut down the windage.

About three years ago there were several predictions made as to the "passing of the piston," but if the above facts are general, it seems as if it will be some time before the last piston will cease to reciprocate.

—o—

Boiler Explosions During 1905.

The recent issue of the *Locomotive* has the following to say in reference to boiler explosions during 1905:

"The total number of boiler explosions in 1905, according to the best information we have been able to obtain, was 450, which is 59 more than were recorded for 1904. There were 391 in 1904, 383 in 1903, 391 in 1902, and 423 in 1901. In several instances during the year 1905 two or more boilers have exploded simultaneously. In every case of this sort we have followed the practice of several years past, and counted each boiler separately in making out the summary, believing that by so doing we should represent the actual damage more accurately than we should if we simply recorded the number of separate occasions on which boilers have exploded.

"The number of persons killed in 1905 was 383, against 220 in 1904, 293 in 1903, 304 in 1902, and 312 in 1901; and the number of persons injured in 1905 was 585, against 394 in 1904, 522 in 1903, 529 in 1902, and 646 in 1901.

"The average number of persons killed, per explosion, during 1905, was 0.851, and the average number of persons injured but not killed, per explosion, was 1.300.

"The year 1905 was signalized by two particularly disastrous boiler explosions. The first of these was the fearful explosion in the factory of the R. B. Grover Company, manufacturers of the Emerson shoe, in Brockton, Mass., which occurred on March 20, 1905, and resulted in the death of 58 persons, and the more or less serious injury of 117 others. The second was the almost equally appalling explosion which occurred, on July 21st, on the U. S. gunboat *Bennington,* which she was lying in the harbor of San Diego, Cal. The *Bennington* explosion resulted in the death of 62 persons, and in injury to 40 others."

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

What Mr. Schneider, Author, has to Say About Ohm's Law.

EDITOR THE PRACTICAL ENGINEER:

I have read with great satisfaction your leading article on what might be called "Ohm's Law Up-to-date." The substitution of I for C in the formula is to my mind absurd and causes great confusion. It has made trouble for the printers, as in many cases the letter I in my manuscript has been set up as figure 1. It is easy to make an error, but if C had been left in the formula, there would have been no reason for mistake.

Furthermore, as you state, the old formula was universal and still comes naturally to one's mind in making mental calculations. However, as the modified formula has been adopted by the majority of writers on electrical subjects, I have been forced to use it in my own books.

If the electrical "400" wish to make a change, why do they not adopt A (amperes) for current, V (volts) for electromotive and O (Ohms) for resistance.

Collinwood, O. NORMAN H. SCHNEIDER.

Points on Gas Engines.

EDITOR THE PRACTICAL ENGINEER:

The general idea in regard to the point of ignition is that it should take place just as the crank is passing the back centre, or perhaps a little earlier. This is not correct, because every case is different, there being three points which should be considered: first, the kind of fuel; secondly, the amount of compression, and thirdly, the speed. The most important of these is the kind of fuel used, which may be divided into four kinds: gas, gasoline, distillate No. 1 and distillate No. 2. I have used all and found each different.

For gas, the most economical point of ignition is about 10 degrees below back centre; for gasoline, about 20 degrees below centre; for distillate No. 1, 28 to 30 degrees below and for distillate No. 2, 30 degrees below but not earlier. This data was taken from an engine with about 85 pounds compression, running at a speed of 200 revolutions per minute. If the compression is much less than 85 pounds, the ignition should in each case be later, as there will be failure in ignition with a fair spark unless the mixture is made much richer than necessary. If the speed is much slower, it may cause a pound or too much back pressure, which would soon damage engine, due to overstrains.

Therefore, I would say try earlier sparking; if it causes a pound with increased speed, cut off fuel until pound ceases. If ignition fails occasionally but the pound still remains, the spark is too early and there is not enough fuel. A little experimenting of this kind will help in many cases.

The reason that different points of ignition are required for different fuels is because gas requires a very short time for complete combustion; gasoline, which is richer in carbon, requires more time to be thoroughly consumed and the distillates still more.

To get the best economy, the fuel must be consumed before the crank passes the centre, as the gases extinguish almost immediately after expansion takes place, that is, so far as complete combustion is concerned. They may be red hot, but no further combustion is taking place, as an indicator diagram will show. Using No. 1 distillate, I have obtained 45 horse power with 5 gallons per hour.

Los Angeles, Cal. J. M.

Insufficient Vacuum Causes Valves to Stick.

EDITOR THE PRACTICAL ENGINEER:

As I have been absorbing valuable information from brother engineers, through your valuable paper, I feel it my duty to help a brother if I can.

As I understand the question: "Why do the valves stick?" I take it to be a Corliss valve gear. Now, the reason why they stick is because there isn't sufficient vacuum in the lower part of the dash-pot on account of the leather being worn. To fix them, take out the dash-pot plunger and on the lower part there will be found a leather cap; just take common wrapping string and wind one or two layers on the plunger between leather and plunger so that it will make a good fit in dash-pot; then you can cushion the top part of plunger to suit you.

Rensselaer, Ind. C. L. T.

Increased Lap and Advanced Eccentric will Cure Sticky Valves.

EDITOR THE PRACTICAL ENGINEER:

In the March issue, N. L. complains of his valves sticking, which brings to mind a very hot argument I had with a man who set up an engine in the rolling mill where I was employed. You must know that the load goes from a very light friction load to one that makes the engine "hang in the hooks," as the saying is, and it will do that from 6 to 10 times in one minute, depending on how fast the rolls are fed.

After this engine was started with nothing but a friction load, the valves were not closing; that is, they cut the steam off, but the returning crank arm closed them the rest of the way or put the lap down where it belonged. The dash-pots were of the vacuum make and were first-class and the valve gear had no superior in my estimation.

After the engine was running a short while and the dash-pots were not closing as they should, the man in charge of setting up the engine said he would have to have pots a size larger. I asked him what difference that would make on a vacuum pot and in this case he claimed it would close the valve. I claimed it would not, as the closing of these valves depended on the vacuum formed in the dash-pot and not so much on the size of the pot, I claiming that if the pots were as big as flour barrels, being vacuum pots, they could not close, as they did not have lift enough with a friction load to form vacuum enough to close them right. He did not agree with me but went to the builders, who told him the pots were all right and plenty large enough.

After the man had gone, I lapped throwed the same steam

valve and they worked all right; that is, I put more lap on the steam valve and advanced the eccentric enough to take care of it. You will then see by doing this, the pots had to rise higher to have the steam valves give the same opening and the dash-pots formed a better vacuum and would close the valves.

If N. L. will put more lap on his steam valves and then advance his eccentric enough to take care of it, I think it will improve the working of his valve gear; that is, if his valve gear is of the Corliss type. My reason for saying so is because he states that with his pressure reduced, his valves work all right, showing to my mind that the valves lift higher and give a better vacuum in the dash-pots which close the valves without any trouble.

Fall River, Mass. M. H. H.

Remedy for Sticky Corliss Valves.

EDITOR THE PRACTICAL ENGINEER:

In relation to what N. L., of Exeter, Canada, states in his letter which appears on page 25 of the March issue, I would say that the cause of his steam valves not dropping at the higher pressure and no load is probably due (assuming the valves, etc., are all right in other respects) to the inability of the dash-pots, or whatever other closing apparatus may be attached, to overcome the unbalanced pressure to which the valves are subjected.

The higher the pressure is on the steam chest side of the valves and the lighter the load, the greater will the difference between the pressure be, during a stroke of the piston. During light loads, the valves do not lift so high as they will if the load is heavier. There will be some pressure between the maximum and minimum at which the valves will drop all right; but when this pressure is exceeded, they will stick and perhaps by examining the dash-pots and repacking them, thus making them "stronger," as it is sometimes tersely expressed, the difficulty may be overcome.

There is hardly any doubt that the dash-pots were designed to close the valves at any pressure that the engine would be required to operate under and so I think that the weakness exists right there. If N. L. will experiment with his dash-pots and make it possible for them to form a better vacuum, or to work a little more freely in case they are stiff in action, I think he may be able to remedy the trouble.

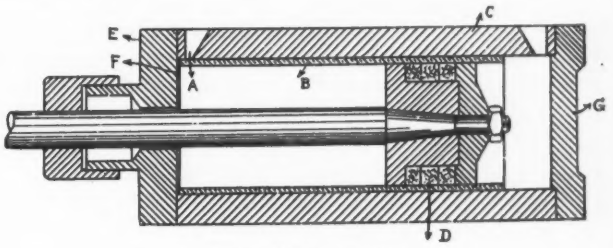
Scranton, Pa. CHAS. J. MASON.

Faulty Cylinder Liner.

EDITOR THE PRACTICAL ENGINEER:

I visited a power plant, the other day, and while looking around the engine and boiler rooms, I noticed that the boiler feed pump was not working and that the engineer was using an injector to supply the boiler with water. My first question was: "What's the matter with your boiler feed pump?" and the engineer's reply was: "It stopped 'dead' yesterday afternoon, and after trying every means I know of to get it to go, I have given it up and I am going to send to the shop for a man to come and examine it today." Naturally curious to know what or where the trouble was, I asked the engineer if he would take the pump apart, so that we could have a look at it, which he did, and the accompanying sketch shows quite clearly what prevented the pump from working.

The pump is a 6" x 4" x 6" duplex, with water cylinders, brass lined. The plunger packing, as shown at D, had been put in and pulled up very tight, in fact, too tight. The pump was then allowed to remain idle about twenty-four hours and upon starting up, the packing gripped the lining and pulled it over the port opening at A, closing it entirely. The only thing to do was to disconnect the two water cylinders, which were cast together, from the cradles at F, and the liner B was then easily removed by a few sharp blows on its end with a block of wood.



Faulty Cylinder Lining

On examination of the outer surface of the liner, it was found to have a great many centre-punch marks around its circumference for two or three inches from either end, proving that originally it was too small, and some workman, thinking it would never be found out, put it into the cylinder. The facts were presented to the manager of the shop, where the pump had been built some years before, and he unhesitatingly made it good.

In fitting the new liner, it was calipered for its outside diameter and found to be seven-thousandths of an inch larger than the bore of the cylinder. It was quite straight, as was the bore of the cylinder. With a suitable one-inch bolt, threaded and with nuts and washers on both ends, the new liner was soon drawn into place. Previous to drawing it in, a liberal supply of linseed oil was put on the surface of the cylinder bore and the outside surface of the tube liner. The end of the liner entering the cylinder was eased off for about 1/8 of an inch with a file to allow it to enter the bore of the cylinder.

Depew, N. Y. C. W. D.

Momentum Makes Injector Work.

EDITOR THE PRACTICAL ENGINEER:

In reference to V. D. B.'s theory,I agree with him so far as a vacuum is created, that the steam does condense, that the steam does give up a number of heat units to the water, causing it to expand, but I think it does more than this, since the injector performs a duty seemingly impossible. Its action is attributed to two principal things: the weight of the water and the force which the incoming steam imparts to it.

Taking up its operation, the steam on entering the injector at a high velocity not only creates and maintains a vacuum, thus drawing a continuous supply of water to it, but as the steam strikes this water and is condensed, it also imparts or gives up its force to it, setting it in motion.

The water now having momentum as well as weight, it is reasonable to assume that it would require a greater resistance to arrest its course than the pressure on the boiler side of the check valve can offer and all resistance is more than overcome.

If Mr. V. D. B.'s theory of expansion is a correct one, why then will an injector not work as well with 25 or 30 pounds steam pressure as with 75 or 80 pounds? The difference in temperature or number of heat units between the two pressures does not seem wide enough to make any material difference in the expansion of the water, so that the injector ought to work equally well in both instances.

White, S. D. H. J. J.

The Theory of the Injector.

EDITOR THE PRACTICAL ENGINEER:

For some time, I have read your valuable paper with great interest and I wish to thank all my brother engineers who have contributed so liberally to THE PRACTICAL ENGINEER, whether to my mind, theory is wrong or right. Now, it seems to me that it is not the reading alone that is valuable, but the fuel which it furnishes to the reader's mind. Mr. V. D. B., of Aberdeen, Wash., has furnished a little of the fuel in his letter: "Why does an injector force water into a boiler?" In that article, he says that he agrees with the editor and Mr. Hawkins in the first part of their explanation, but he takes exception to the rest of it.

Now I must take exception to Mr. V. D. B., where he explains that it is the expansion force of the water that causes it to flow into the boiler. To begin with, I will say that I have been taught that an expansive or non-expansive fluid will, when confined under pressure, exert an equal pressure in all directions, its own weight being added to the pressure at the bottom.

This common law leads me to believe that if the water in the injector had only expansive force, it would rush out of the suction or the overflow, as they would be the easiest means of exit. It might clear up this idea to consider that the water in an open or closed feed-water heater is just as expansive as that delivered by an injector and yet a pump is required to force it into a boiler. I would rather not consider water at any temperature as an expansive or compressive fluid.

The theory of the injector, so far as I am able to comprehend it, is very short and concise. The nozzles must be so arranged and proportioned, according to the working conditions, that when the steam rushes through them, a partial vacuum is formed, drawing water to the mixing chamber and mixing it with the steam. The vacuum causes the steam to flow with a high velocity and it imparts its kinetic energy to the water. This energy is sufficient to drive a volume of water into the boiler at a pressure exceeding the pressure in the boiler from which the steam came.

Sioux Falls, S. D. R. L. W.

Why an Injector Forces Water into a Boiler.

EDITOR THE PRACTICAL ENGINEER:

Referring to the subject of: "Why does an injector force water into a boiler," I wish to submit the following:

It may at first seem inconsistent that steam can flow from a boiler at say 70 pounds pressure and force water back into the boiler against the same pressure. It is, however, only an example of heat changed into work. Each pound of steam entering the injector gives out about 900 British Thermal Units, depending upon the pressure, and each of these heat units is capable of developing 778 foot pounds of work; consequently, the steam jet possesses ample energy to force the water into the boiler. In fact, only a small per cent. of the energy is so expended, the larger part of it being utilized in heating the feed water.

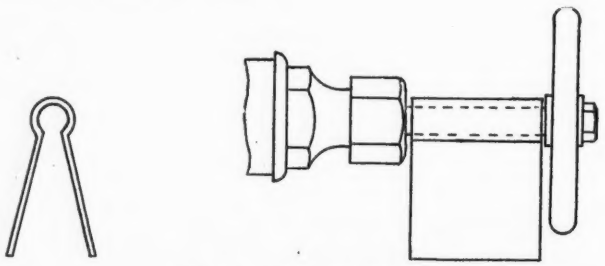
In addition, I would state that the action of the injector is simply to give the mass of water in the combining chamber of the injector a velocity nearly equal to the velocity of the steam, so that it forces it into the boiler. The amount of work a moving body is capable of doing is equal to the product of its weight in pounds by the square of its velocity in feet per second and the product divided by 64.32. Hence it will be seen that the weight of the water when moving at the very high velocity of a jet of steam has an amount of kinetic energy that is much more than sufficient to lift the check valve and overcome the boiler pressure.

Wilmington, Del. W. D. W.

Three-Way Valves.

EDITOR THE PRACTICAL ENGINEER:

In looking over the February issue, I notice that J. H. S. says he was in a plant where they had the three-way valves on the water columns wired fast. I think this is a poor way and I don't think that the water column can be blown out very often, because in the case mentioned, the wire that holds the wheel would be too hot to handle.



Guide for Three-Way Valves

The way I have my three-way cocks is this: I have a piece of sheet brass, bent as shown in sketch, and when the valve is open I slip it over the stem of the valve, between the wheel and the gland, so that a glance will tell if the valve is open. If this guard is not on the stem, there is a chance of the valve being closed. When I blow out the water columns, which I do every day, I take off the guard, shut valve and blow out with steam, then open valve wide and replace guard. When the guard is in place, I know the valve is open.

Danbury, Conn. J. M.

About Some Troubles and Remedies.

EDITOR THE PRACTICAL ENGINEER:

I used to have trouble with the whistle pipe freezing during the night when the weather was cold. It would freeze where the pipe comes out of the roof up to the whistle. To get over the trouble, I put in a valve at some handy place in the boiler room, and a tee between this valve and the whistle. Now, at night, when the weather is cold, I close the valve in the boiler room and drain the pipe between the valve and whistle and I have had no more trouble with the pipe freezing.

The cylinder head of our engine is quite heavy and it takes two men to take it off. I have made it a practice to take off

the head about every two months to see if the cylinder and piston are in good condition. At one time when we were taking off the head we accidentally let it drop and so as not to have this happen again, I made a bench, one end of which goes close under the bottom edge of the head and rests on the foundation stone. All we have to do now is to slide the head away from the cylinder and lay it on the bench. One man can do this without having any trouble. I have made the bench long enough so that in case I have to take out the piston I can let this rest on the bench also. The bench is made out of some 2 x 14-inch lumber.

A short time ago, there was a clicking noise in the head end of my engine cylinder, which is of the Corliss type. Upon examining the cylinder and piston, I could find nothing wrong with them. I was puzzled to know what was making this noise until, one day, when I was standing at the head end of the cylinder, I noticed that the packing gland of the valve stem would move when the valve was lifted up to admit steam. I tightened up the gland a little, when the noise in the cylinder stopped. I knew at once where the trouble was. There was some play between the stud-holes of the gland and the studs so that when the valve was lifted up the gland would also move and strike the studs. This caused the noise that I thought was in the cylinder. The oil hole in the gland had got stopped up so that no oil could get to the valve stem and the gland had to move with the stem. As the packing had not leaked, I did not pay much attention to it until I saw it move.

Milwaukee, Wis. H. J.

Can a Fish Live in the Suction Pipe of a Pump?

EDITOR THE PRACTICAL ENGINEER:

I have in my care a pump which is used for pumping river water and which is used steadily in the winter time. The pump has about 15-foot lift and has been in steady use about two months. The suction pipe is 4 inches in diameter, with a cast-iron screen in the end, having ¾-inch holes. The other day, the pump gave out all at once and upon taking off the check valve cover, which was located about 25 feet from the end of the pipe, I found a fish that weighed about two pounds. The fish must have got in the pipe when little, but the question is, could a fish live in the suction pipe for any length of time when the pump was running? Would like to hear from some brother engineers about this.

Rockford, Ill. O. G.

A Lesson on Segments.

EDITOR THE PRACTICAL ENGINEER:

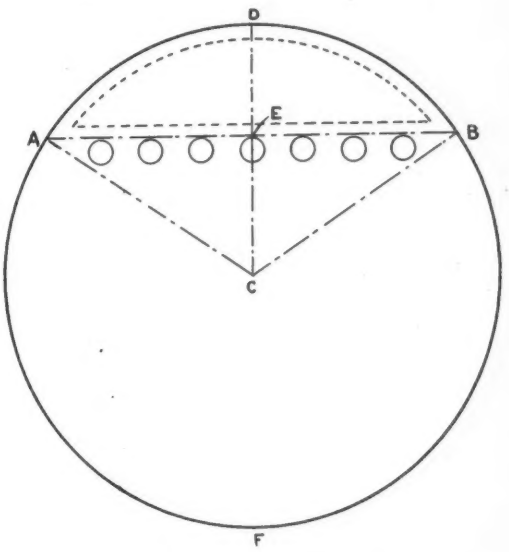
I think it might be of interest to some of your readers, who have not a table of areas of segments and who do not know how to figure them, to know a way to practically work it out. The only thing to be remembered is the simple rule for plane triangle areas.

Referring to the figure, the line ADB is called an arc, as is also AFB. The figure contained by either of these arcs and the common line AB is called a segment. The line AB is called the chord and the figure ACBD, which is bounded by the radii, AC, BC, and the arc ADB, is called a sector of a circle.

Now, it is evident that if the area of the sector ACBD can be found and the area of the triangle ACB be subtracted from it, the remainder or the area of the segment ADB can be found. If it is a question of how much water the boiler holds to a certain water level, this segment area added to the area of the tube ends and then subtracted from the whole area of the boiler end gives us the water area of the end of the boiler. The tubes and shell, however, act as stays and in practice the tubes and shell may be taken to represent ½ a row of stays each so that the smaller segment is that which must be stayed. For convenience the distance of this segment from the shell and tubes is taken as 3 inches, so that it is area of a segment 3 inches from the shell and 3 inches above the tubes that must be found and which requires staying.

Now, the area of the triangle ACB is side AB × ½ CE and the area of the sector ACBD is the arc ADB × ½ CD. Subtracting from this last result the area of the triangle ACB, the area of the segment ADB is left.

To measure practically the length of arc ADB, a blacksmith's



A Lesson on Segments

measuring wheel may be used or a template of iron wire can be bent and then rolled on a rule or tape. It will be seen from these operations that it makes no difference whether a triangle has a straight line or an arc of a circle for a base, the area in both cases being the base multiplied by ½ the perpendicular height. This statement may be carried still further by saying that the area of a circle may be figured as a triangle because, by multiplying the circumference by ¼ of the diameter, the area may be obtained and ¼ the diameter is ½ of line CD or ½ of the perpendicular height. The length of the arc ADB will always be found to be very nearly equal to (8 DB — AB) ÷ 3.

Boston, Mass. W. M. FRANCIS.

The watts per candle power of incandescent lamps vary with the variations in the voltage. If the voltage is increased, more current passes through the lamp and the filament becomes hotter and gives out more light. The increase in light is greater than the increase in watts, so that the higher the voltage the less the watts per candle power, but the shorter the life of the lamp.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

Methods for Lifting Quicksand Wanted.

EDITOR THE PRACTICAL ENGINEER:

At the place where I am employed, we started to dig a supply well by digging a hole in the ground to sink an old boiler shell into it, all the drains to be run into it so that we could use the water again for various purposes. After we dug down about 10 feet, we struck quicksand and began getting seep water, so we turned the shell on its end and tried to sink it by digging out the inside, but the water soon came in so fast that we had to give it up.

We then rigged up an ejector and put it into the shell, and also turned a syphon from a nearby wheel-pit into it to stir up the sand, but contrary to expectations, the ejector would not bring up any sand. As the lift is only about 25 feet, we are at a loss to know what to do. If it would not be asking too much, we wish you would publish this, as some engineer, who may have had a similar experience, may be able to give us some advice.

St. Louis, Mo. S. P. N.

Horse Power from Voltmeter and Ammeter Readings. Heat Given out by Melting Ice. Safety Valves.

EDITOR THE PRACTICAL ENGINEER:

Kindly answer the following questions:

(1). If the average reading of the voltmeter is 541 volts and the average reading of the ammeter is 86 amperes, what is the horse power developed? If the efficiency of the generator is 92 per cent. and 17.5 per cent. is wasted in overcoming friction, what must be the indicated horse power of the engine?

(2). How many pounds of water at 60 degrees can be changed to steam at 90 pounds gauge pressure by the burning of 7 pounds of hydrogen, assuming that 23 per cent. of the heat is wasted?

(3). How much heat is absorbed in changing 85 pounds of water at 50 degrees, into ice at 32 degrees? How much heat is required to change 43 pounds of ice at 20 degrees into water at 63 degrees? If all this heat given out could be utilized, how high would it lift 85 pounds?

(4). What should be the area of a safety valve of a 60 horse power boiler, steam pressure 90 pounds?

Cornwall-on-the-Hudson, N. Y. W. S.

(1). The product of volts times amperes gives watts, and since there are 746 watts in a horse power, by dividing the number of watts by 746, the horse power developed will be obtained. In the given problem, $(541 \times 86) \div 746 = 62.3$ horse power. The efficiency of the generator being 92 per cent., $62.3 \div 0.92 = 67.7$ horse power put into it. Since 17.5 per cent. of the energy of the engine is wasted in friction, the indicated horse power of the engine must be $67.7 \div 0.825 = 82.1$ horse power.

(2). The number of heat units given out by one pound of hydrogen is 62,000, so that 7 pounds would be capable of giving out 434,000 heat units, which at an efficiency of 77 per cent., gives 334,180 heat units available for evaporation. The total heat required to raise one pound of water from 60 degrees into steam at 90 pounds gauge pressure is 1154.8 heat units, so that under the given conditions, 7 pounds of hydrogen will evaporate $334{,}180 \div 1154.8 = 289.3$ pounds.

(3). The latent heat in one pound of ice at 32 degrees is usually given as from 142 to 144 heat units per pound. Taking 142 heat units as the amount given out by one pound and since one pound of water gives out one heat unit for every degree it is cooled, the total amount of heat that must be absorbed in changing 85 pounds of water at 50 degrees into ice at 32 degrees is $85(50 - 32 + 142) = 13{,}600$ heat units.

In changing 43 pounds of ice from 20 degrees, into water at 63 degrees, the calculations involve the specific heat of the ice, which is .504. In raising the 43 pounds of ice from 20 to 32 degrees, it will require $43 \times 12 \times .504 = 260$ heat units. Raising the ice from 32 degrees into water at 63 degrees will require $43(63 - 32 + 144) = 7525$ heat units, so that the total heat required will be $7525 + 260 = 7785$ heat units. One heat unit is equivalent to 778 foot pounds of energy, so that, if all the heat units were available for work, the 85 pounds would be lifted $(7785 \times 778) \div 85 = 71{,}255$ feet.

(4). There are various rules given for finding the area of a safety valve, but the rule required by the Philadelphia Bureau of Steam Engine and Boiler Inspection is usually looked up to as a good one.

This rule states that every boiler when fired separately and every set or series of boilers when placed over one fire, shall have attached thereto, without the interposition of any other valve, two or more safety valves, the aggregate area of which shall have such relation to the area of the grate and the pressure within the boiler as is represented by the formula

$$A = \frac{22.5\ G}{P + 8.62}$$

in which A is the area of the combined safety valves in inches; G is the area of grate in square feet; P is the gauge pressure to be carried per square inch in the boiler.

In the given problem, the steam pressure is equal to 90 pounds, so that it will require 0.23 square inches for every square foot of grate surface in the boiler. A boiler of 60 horse power would have nominally about 25 square feet of grate surface, so that the area of the safety valves (which would be divided between two valves) would be $25 \times 0.23 = 5.75$ square inches.—[Ed.]

When soldering small wires, acid should never be used, as it is certaain to eat through both wire and insulation. A good non-corrosive soldering flux is an alcoholic solution of rosin.

Injector and Inspirator.

EDITOR THE PRACTICAL ENGINEER:

Please explain in your next issue the difference between an injector and an inspirator.

Fair Haven, Mich. W. F. Z.

There is practically no difference between an inspirator and an injector. The name inspirator was given to the double-jet lifting injector by John Hancock, of Boston.—[Ed.]

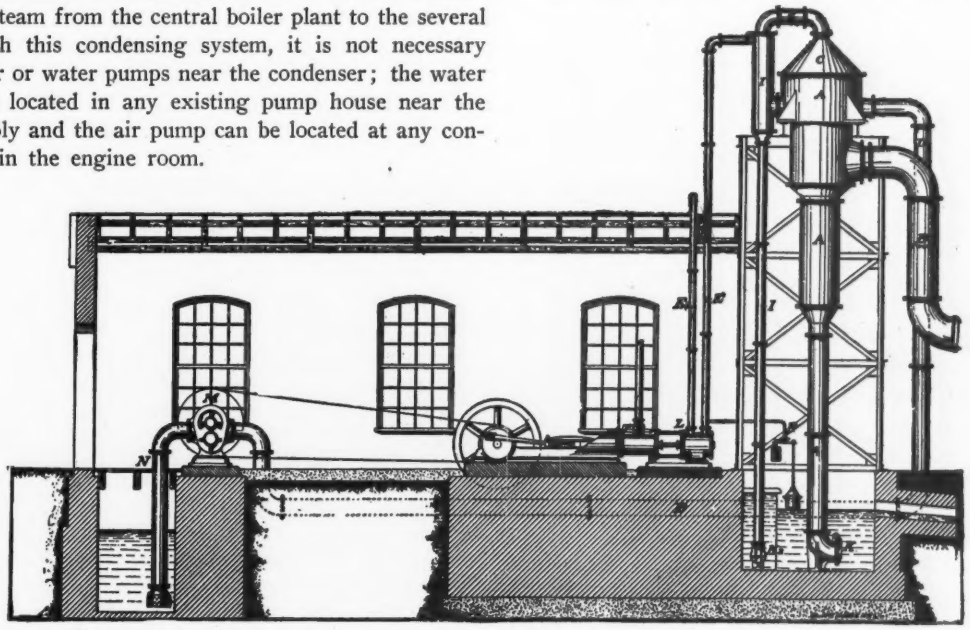
The Weiss Condenser.

EDITOR THE PRACTICAL ENGINEER:

Will you kindly explain to me the system and principle upon which the Weiss Jet Condenser works?

Edmonton, Canada. F. H. S.

The Weiss Condenser is especially adapted to plants having a number of condenser engines, as it can be placed at any convenient point and the exhaust from all the engines piped to it can be connected in the same manner as the main steam pipe conveys steam from the central boiler plant to the several engines. With this condensing system, it is not necessary to place the air or water pumps near the condenser; the water pump may be located in any existing pump house near the source of supply and the air pump can be located at any convenient point in the engine room.



The Weiss Condenser

By referring to the accompanying illustration, a lay-out of this type of condensing system is shown. The water enters the main condensing vessel through the pipe D and flows out by gravity through the barometric tube A. The exhaust steam enters through the pipe B, and coming into contact with the cold water, is condensed. Any air and vapors which are not condensed pass upwards through the condensing water and are drawn off from the top of the vessel by the dry air pump L. Any moisture that passes over with the air is separated at I before reaching the air pump and flows out through the small barometric tube to the hot well.

The water pump M supplies the injection water and the crank and fly-wheel engine T drives the water pump by a belt and the air pump direct, the latter being connected tandem to the steam cylinder. The arrangement shown is not arbitrary, however, as any modification of this arrangement may be made to suit local conditions.

Temperature of Water at Different Boiler Pressures. Vacuum in Injectors.

EDITOR THE PRACTICAL ENGINEER:

I would like to ask three questions through the columns of your paper, as we have had several arguments over them:

(1). Is water in a boiler working with 100 pounds pressure at a higher temperature than water in a boiler working at 80 pounds pressure? If so, why?

(2). In regard to the article contributed by M. H. S., in the February issue, could he have changed the motion of the slide valve engine as easily as if it had cut-off at ¼ stroke?

(3). Is there any vacuum in an injector after it once gets its water going into the boiler?

Groton, Mass. C. J. W.

(1). Water in a boiler working with 100 pounds pressure is at a temperature of 337 degrees, while the temperature of the water in a boiler working with 80 pounds pressure is only 323 degrees, or 14 degrees lower. The reason for it is due to the fact that the higher the pressure in the boiler, the higher must be the temperature to make the water boil.

(2). Certainly, if the design of the engine permitted it.

(3). This will depend on the kind of injector. A non-lifting injector will probably not have a vacuum formed in it after starting but a lifting injector must have a partial vacuum formed in it or else the pressure of the atmosphere acting on the source of supply could not force the water into the injector. —[Ed.]

Boiling Point of Brine.

EDITOR THE PRACTICAL ENGINEER:

Kindly let me know if brine boils at a higher temperature than water and if so, how much?

Cincinnati, O. W. A. S.

The boiling point of brine is higher than that of water but just how much higher depends upon the amount of salt that the water contains. Under atmospheric pressure, satu-

rated brine boils at 226 degrees Fahr. Weaker brine is higher than the boiling point of pure water in the proportion of 1.2 degrees for each $^1/_{32}$th part of salt that the water contains. —[Ed.]

Lap. Lead. Vacuum. Safety Valve.

EDITOR THE PRACTICAL ENGINEER:

Kindly answer the following questions:

(1). A flat brace, 2½" x ⅜", is held by four rivets; what would be the diameter of the rivets so that the combined strength would equal that of the brace?

(2). What part of a boiler is subjected to run first in case of low water?

(3). What is the lap on a valve, and its object?

(4). What is the lead of a valve, and its object?

(5). What is the object of connecting a condenser to an engine?

(6). What is a vacuum, and how is it maintained?

(7). How would you find size of a safety valve for new boiler?

Fair Haven, Mich. W. F. Z.

(1). The area of the brace is $2\frac{1}{2} \times \frac{3}{8} = {}^{15}/_{16}$ths of a square inch, so that each rivet would have to have an area of $^{15}/_{64}$ths of a square inch, considering the strength of the rivet and the brace to be the same per square inch. The diameter of each rivet should therefore be $^9/_{16}$ths of an inch.

(2). This depends upon the type of boiler used. If it were a locomotive boiler, the crown sheet would probably be damaged first; if a return tubular boiler, the upper row of tubes; if a water tube boiler, probably the lower part of the steam drum or the upper part of the water leg.

(3). The lap of a valve is the amount the edges of the valves extend over the ports when the valve is in the centre of travel. The object of lap is to allow the steam to work expansively in the cylinder.

(4). Lead is the amount the port is open at the beginning of the stroke. The object of lead is to allow some steam to remain in the cylinder at the end of stroke before admission begins, so that it will bring the reciprocating parts to rest and allow them to reverse their motion more easily; it also allows admission of steam at boiler pressure to enter the cylinder as the piston is passing dead centre without undue shock.

(5). The object of using a condenser in connection with a steam engine is to remove the back pressure due to atmosphere by condensing the exhaust steam and thus producing as large a vacuum as possible on that side of the piston which is open to the exhaust.

(6). A perfect vacuum contains no pressure and the space it occupies contains absolute emptiness. It is impossible, however, to attain a perfect vacuum in practice as there is always some small residuum left, but the smaller the amount of this residuum, the higher the vacuum is said to be. The vacuum in a condenser of a steam engine is maintained by condensing the steam with cooling water and drawing off the water of condensation as quickly as possible, together with the attenuated vapor.

(7). Multiply the grate area in square feet by 22.5 and divide the product by the sum of the steam pressure you intend to carry and the constant 8.62. The quotient will be the area of the safety valve required in square inches.—[Ed.]

Rule for Finding the Proper Mixture of Acid and Water for the Electrolyte of Storage Batteries.

EDITOR THE PRACTICAL ENGINEER:

When I must fill up a secondary battery for the first long charge and haven't at hand sulphuric acid of the proper density, what formula should I use in order to know how many parts of water and acid to mix together; for instance, if the acid is at 60 degrees Baume, how much water and acid must I mix to get the needed density? I know many practical tables which give me the proportions, but I want to know if you can give me any formula for it.

Quincy, Mass. C. P.

Pure sulphuric acid has a specific gravity of 1.850 and water has a specific gravity of 1.00. The mixture of sulphuric acid and water, which is commonly used in storage batteries, has a specific gravity of 1.200. The proportions of acid and water required under these conditions are 77 parts water and 23 parts acid.

The formula for finding the proportions in the above case can be derived from the formula

$$1.85\ x + y = 1.20$$
$$x + y = 1$$
$$\text{therefore } 1.85\ x + 1 - x = 1.20$$
$$\text{or } .85\ x = 0.20$$
$$\text{therefore } x = 23 \text{ parts}$$
$$\text{and } y = 77 \text{ parts}$$

in which x = number of parts of acid, y = number of parts of water.

Now when the acid has a density of 60 degrees Baume, the specific gravity is 1.652, so that the formula will become

$$.652\ x = .20$$
$$\text{or } x = 30 \text{ parts}$$
$$\text{and } y = 70 \text{ parts.}$$

The rule can then be given as follows: Subtract one from the specific gravity of the acid and divide 0.2 by the remainder; the result will be the number of parts of acid required. The number of parts of water required is obtained by subtracting the number of parts of acid from 100.—[Ed.]

Peculiar Action of Piston During a Fire.

EDITOR THE PRACTICAL ENGINEER:

In looking over the March number, I notice an article about the explosion of a solid piston. Now that brings to mind something that happened to an engine I had charge of not long ago. It was a 15½ x 26 and one night the factory burned down and the next morning I found the piston head 150 yards from the engine. It had found its way through two fences and one stable wall. Now, what caused that head to be blown so far with the engine standing still?

Henderson, Ky. J. W. V.

Knocking in High-Speed Engines.

EDITOR THE PRACTICAL ENGINEER:

I have in charge a small high-speed engine. When loaded it runs quiet and gives a good card but when running light, it makes a bad knocking noise; what can be the reason for this?

Chicago, Ill. R. J. M.

If the engine belongs to the single-valve automatic type, the trouble is probably due to the lifting of the valve at the end

of each stroke. With this type of engine the cut-off shortens as the load decreases and at the same time the compression increases. It often happens that the compression pressure exceeds the boiler pressure, in which case the valve is raised from its seat each stroke, causing a bad knocking noise in the engine.—[Ed.]

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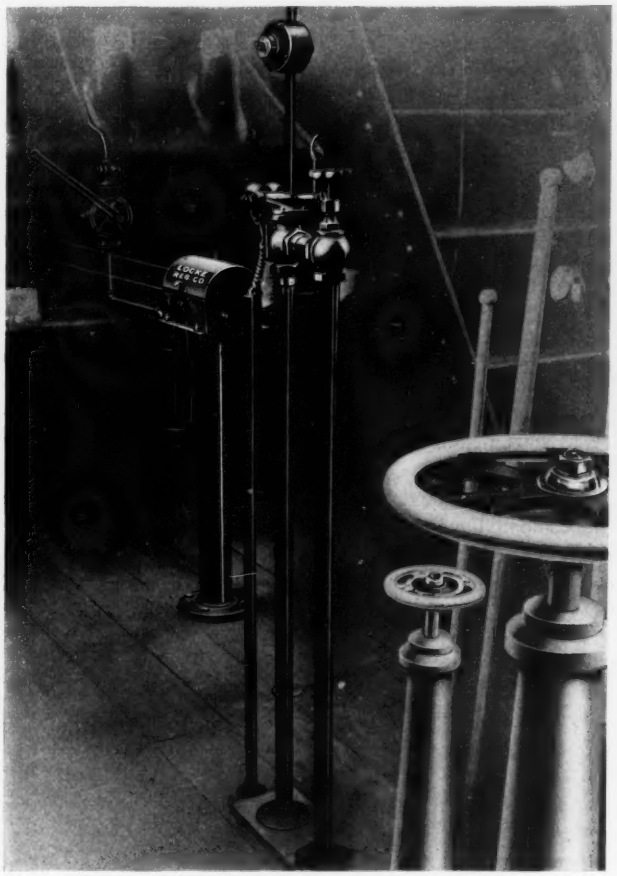
The Locke Automatic Engine Stop and Speed Limit System.

The Locke Automatic Engine Stop and Speed Limit System permits of the immediate stopping of the engine from any part of the plant and makes a fly-wheel explosion, such as described on pages 8 and 9 of this issue, absolutely impossible. In case of an accident to the engine itself, the breaking of a belt, steam pipe, or other accident, the engine can be stopped without going to the throttle. In that way,

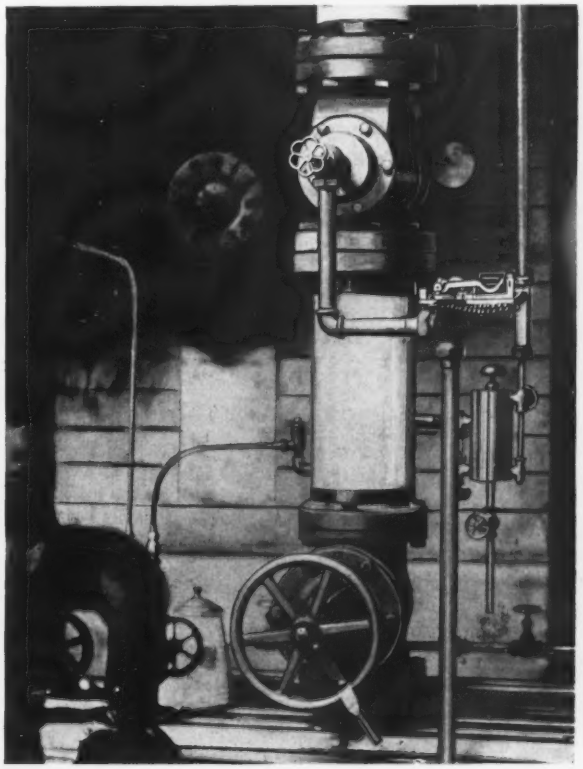


The Locke Speed Limit Govenor and Connections

should anything happen, any employee, by pushing a button or breaking the glass of a circuit closer, can stop the engine immediately without signalling the engineer. At the same time, a large gong rings in the engine room, which summons the engineer and warns the firemen to shut off their fires.

The Locke System also has an independent governor operated from the main shaft next to the fly-wheel, whereby, if the engine from any cause, such as the breaking of main belt, slipping or breaking of governor belt, attains an unusual speed, the Locke governor makes electric connections with the automatic throttle and the engine stops immediately, thus making it impossible to burst the fly-wheel by increased velocity.

When it is not desirable to remove the throttle valve, an automatic engine stop valve is used, which is actuated by an auxiliary electric valve. The purpose of this valve is to provide means of shutting off steam from convenient points



The Locke Engine Stop and Speed Limit System

throughout the plant by means of push buttons or "break glass boxes" or when the speed exceeds a certain limit. The valve is a balanced valve with a cylinder and piston at one end. Whenever steam is exhausted from the top side of the piston by the electric actuated auxiliary valve, the piston is forced to the upper end of the cylinder by the steam pressure, thereby closing the main valve. The only adjustment necessary after closing is to latch the auxiliary valve. When this is done, the pressure above the piston will become equalized, allowing the main valve to be forced open to its normal position by the steam acting on the differential poppets in the auxiliary electic valve.

When it is desirable to remove the throttle valve, the Locke combined throttle and automatic engine stop is used. The purpose of this valve is to provide a throttle which can be opened or closed at will without any encumbrance and at the same time have a practical automatic engine stop which can be operated from convenient points throughout the plant or automatically when the speed increases above normal.

To prevent the speed from increasing above a fixed limit, an automatic speed limit governor is used, which trips the electric device of the main shut-off valve and closes the same. The governor used is of the Pickering type and is adapted to run both ways. It is generally belted to the engine shaft and connected in the wiring circuit as any circuit closer would be.

The speed limit is set to operate at any number of revolutions. Whenever this speed is exceeded, the governor balls are thrown outward and the spindle operates the auxiliary valve, which in turn closes the main valve.

The Locke Automatic Engine Stop and Speed Limit System is manufactured by the Locke Regulator Co., of Salem, Mass., who will be pleased to give any further information desired.

The Exacto Packing Gauge and Cutter.

When packings for rods are bought in continuous lengths, it is necessary to cut the packing so that when it is bent around the rod, it will make a perfect fit. This, it is well known, is rather a difficult operation. If the packing is cut too short, it will not close at the joint and if cut too long, it will have to be shortened on account of the overlap.

To overcome this objection to continuous length packings, Green, Tweed & Co., of 109 Duane St., New York City, have recently placed a device on the market which will enable the

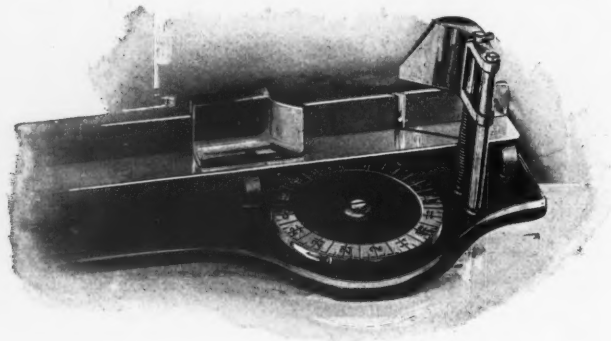


Fig. 1

engineer to cut continuous length packing in such a manner as to secure absolute accuracy and perfect fit.

This device is known as the Exacto Packing Gauge and Cutter and is shown in the accompanying illustration. Fig. 1

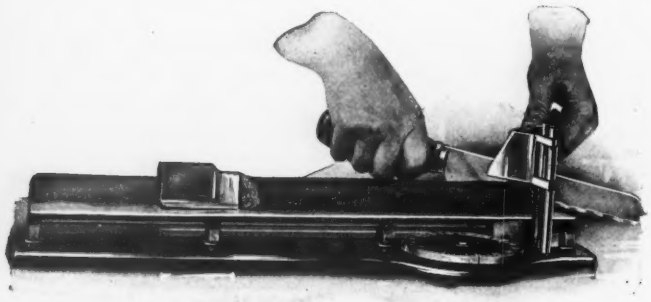


Fig. 2

shows the device all ready for use. The packing is inserted in it and by pressing the thumb of the left hand upon the knife guide, a true mitre is cut which when bent in a ring makes a perfect joint.

To get the exact length, the gauge is set by following the figures on the dial, the dial being set to the diameter of the packing plus the diameter of the rod you wish to cut the packing to fit. For instance, if the rod is 2 inches and the packing one inch in diameter, add them together and set the dial at 3 inches. Having set the gauge to the proper length, it can be secured by means of a set screw so that every length of packing cut will be exactly the same.

The arrangement for cutting the exact length is shown in

Fig. 3

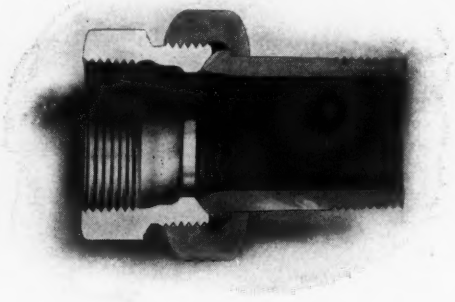
Fig. 2. With the thumb, the knife guide is pressed down firmly, holding the packing in place. A knife of the serrated edge variety is then inserted and the cut made as shown. The result is a ring with true beveled edges which will, if care has been exercised in the operation, form a ring, as shown in Fig. 3, which will exactly fit the rod.

With this arrangement not only will the packing be cut to exact fit, but there is no possibility of waste from errors in cutting, no loss of time in fitting the packing to the rod and if the packing is of proper design, a tight joint and workmanlike job are assured. For further information, write the manufacturers at the address given above.

The Kewanee Union.

The trouble experienced in disconnecting the ordinary union after it has been in use a few months is well known. It is generally rusted together so tightly that great force is necessary to start it, which frequently injures the union so that it has to be replaced.

To overcome these difficulties, the Kewanee Union, shown in the accompanying illustration, was patented and placed on sale by the Western Tube Co., Kewanee, Ill. It consists of only three parts: a brass head piece, a malleable iron tail piece and



Kewanee Union

a malleable iron connecting nut. This gives a brass-against-iron connection which does not corrode. The union can be disconnected at any time without trouble and without injury to the union.

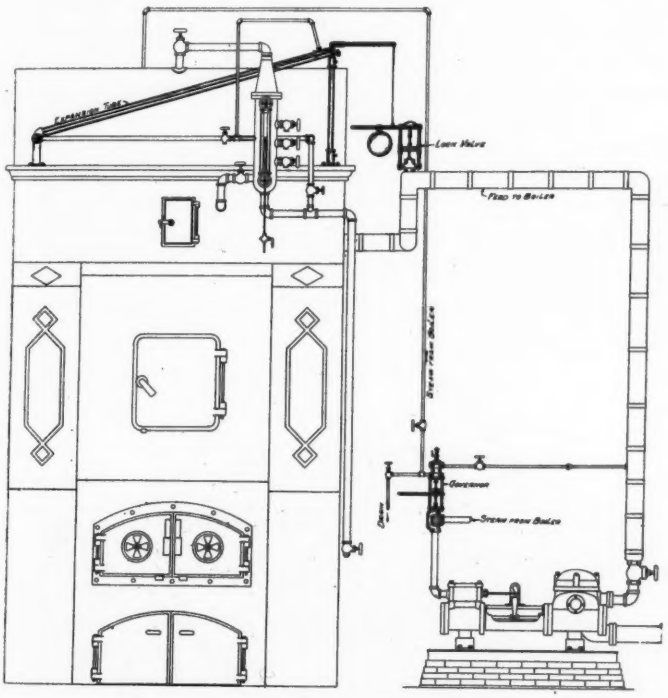
Another feature of this union is its self-seating ground ball joint, which makes a perfectly tight connection without a gasket. The fact that the joint can be made tight even when the pipe is out of line means a great saving of time and trouble.

These features are said to have made the union immediately popular, so that it has been adopted by railways and other large users. The sale, it is said, is now over a million a year.

The unions are on sale by all jobbers, but the manufacturers will send a sample union, free of charge, to any engineer who will mention this paper and agree to test it. Address, The Western Tube Co., Kewanee, Ill.

The Copes Automatic Feed-Water Regulator.

It is a generally-recognized fact that irregular feeding is bad for a boiler and that the greatest economy of fuel can be had with a boiler whose water level is maintained constant. This fact is taken advantage of in boiler tests for economy and throughout the test it is advisable to so regulate the pump or injector that the water level remains at some fixed point, which is generally at the middle gauge cock. In general practice, however, this is very hard to attain, as it requires the constant attention of at least one man and when the feed pump is located some distance from the boiler, the task becomes still more difficult and arduous.



The Copes Automatic Feed Water Regulator.

Aside from the economy which is gained by maintaining a fixed water level, it is advisable not to have the water level too high or too low for other reasons. If the water is carried too high, there is a tendency for the boiler to prime, which not only means a loss in economy but the resultant wet steam has a cutting effect on engine cylinder and if the water is too low, it has a ruinous effect on the boilers.

To overcome these difficulties and to maintain a constant flow of water into the boilers proportionate to the load upon them, the Copes Automatic Feed-Water Regulator, shown in the accompanying illustration, was designed and it has been in constant use for a number of years. The complete equipment consists of one regulator and one pump governor, both of which are free from diaphragms, rubber gaskets, springs or floats.

The operation of the regulator is as follows: The water column is tapped with a ⅜-inch pipe at the water level of the boiler, which pipe also connects to the expansion tube. When the water falls below the opening of the pipe in the water column, the steam enters the tube, causing the same to expand, and this in turn opens the lock valve on the feed line. When this lock valve is released, the pressure, being reduced in the feed line, causes the piston in the governor to rise and admit steam to the pump. As soon as there is sufficient water to cover the opening tapped in the water column, the expansion pipe contracts and closes the lock valve, creating a pressure greater than the steam in the boiler. The piston in the governor moves down, shutting off the steam to the pump.

As will be noticed, the water level in the boiler cannot exceed a variation of ¼ of an inch at any time, thus insuring a constant operation of the pump, a regular flow through the feed-water heater with a resultant constant temperature of the feed water.

The Copes pump governor used in connection with the feed-water regulator has also a wide application for house tanks. The hydrostatic pressure for stopping the pump is exerted above the piston of the governor through a small overflow pipe in the tank. When the level falls below a certain amount in the tank, a constant water pressure below the piston or the counterbalance weight alone is utilized to regulate the governor which starts the pump again.

These regulators and pump governors are guaranteed for three years and are furnished on thirty days' trial. For further information, address Wilfong and Wiltbank, 420 Mutual Life Building, Philadelphia, Pa.

The Eccentric Club Dines.

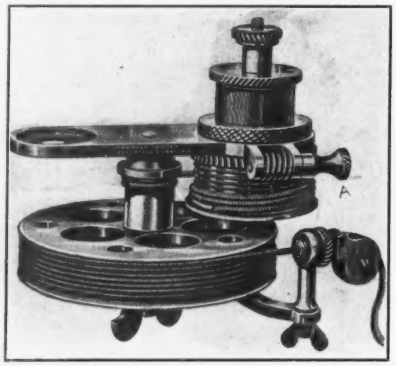
The Eccentric Club of Engineers held their second annual banquet at Atlantic City, on Wednesday evening, March 7th. If the handsomely decorated menus are any indication of the smooth running time they must have had, each eccentric was well oiled and each must have tried to attain the proper lead with a resultant efficiency of 120 per cent. hot air and other things.

Each course served was appropriately dedicated to one of the members or visitors. Those present were John R. Livezey, C. J. Curran, H. G. McConnaughy, T. B. Harper, J. C. Quinn, W. E. Hexamer, W. B. Severn, David E. Haire, W. S. Price, J. H. Best, A. M. Plummer and R. S. Peterson. If any of those present are asked whether they had a good time they will answer with a little chuckle and a far-away look.

On all polyphase circuits, the total load on the dynamo should be as equally distributed between the different phases as possible. If the system is of the three-phase type, each phase should carry as near one-third the load as possible; if a two-phase system, each phase should carry one-half the load. This is especially true of inductive loads, which should be distributed between the phases, for if one phase contains a very much larger inductive load than the other, the power factor will be different and the voltage regulation is likely to be poor.

Improvement in Reducing Wheels.

Every engineer knows of the trouble and annoyance caused by slack cord between crosshead and reducing wheel and how hard it has been to remedy it. We present herewith a cut of the well-known Victor Reducing Wheel, with a patented adjustable spring tension attachment. This enables the user to adjust the tension of the spring while engine is in motion, to suit any practical speed. Heretofore, the spring had to be set



The Victor Reducing Wheel

to the required speed to keep the cord taut, but it would not suit any higher or lower speed without taking apart and regulating to meet each condition. This trouble has been completely overcome by the new attachment. The spring tension is regulated by the projecting thumb-screw, as shown in cut. This screw-worm meshes with a worm-wheel which is loose on the spindle and of such a low pitch it remains wherever set, a few turns of thumb-screw either way tightens or loosens the spring. They are made by James L. Robertson & Sons, Inc., 205 Fulton St., New York, who will be pleased to send circular.

The Youngstown Steam Trap.

A steam trap of unique construction, for which the claim is made that it is extremely simple in operation, is manufactured by the Youngstown Steam Trap Company, Keystone Bank Building, Pittsburg, Pa. The accompanying illustration, Fig.

Fig 1

1, shows the trap assembled ready for working, and the longitudinal and cross sections of the trap are shown in Figs. 2 and 3, which explain its construction.

The operation of the trap is as follows: The condensation passes into the pivot pipe at U, from thence into the receiving vessel through ports R and P. When the receiving vessel is filled with water, the trap rocks from the arm G, on which it rests while filling, to arm I and the water is discharged from the trap through the discharge pipe C, through ports W and X to the ball valve chamber. While the trap is rocking from the arm G to the arm I it moves the ball valve L off the port

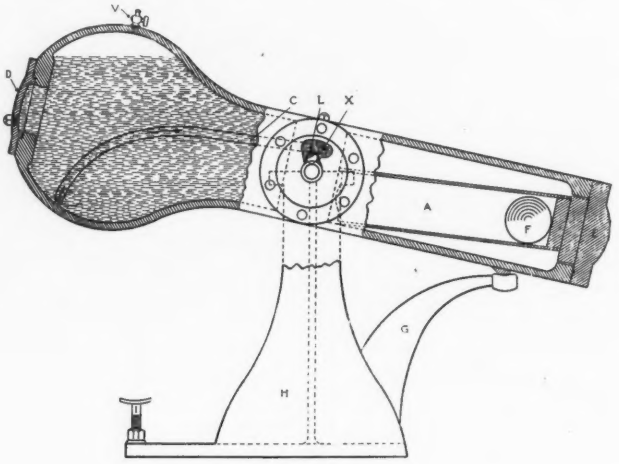


Fig 2

M, an operation which allows the water to pass from the discharge pipe C to J, the end of the trunnion.

In discharging, before the trap reaches a horizontal position,

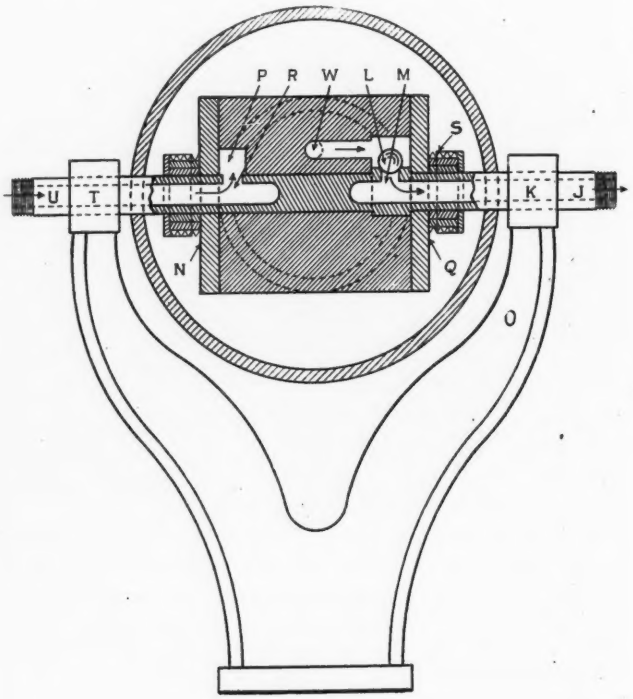


Fig. 3

the ball F rolls from its position in the balance end of the trap at E to the middle of the trap which gives the water end the aid of the counterweight to enable it to discharge. When the water has been discharged from the trap, the balance end being

heavier than the water end causes the trap to rock back to its original position for filling the ball F rolling back to its position at E in the balance end of the trap. In case of a gush of water, the trap remains in a discharging position, thereby taking care of the sudden accumulation of water.

If the trap is placed slightly above the water line of the boilers, it will return the water directly to the boilers. The trap operates without any wire-drawing effect through the ball valve, because the valve is moved entirely off its seat when the trap swings into its discharging position, and any mud, scale or foreign matter which may be in the water is blown through the large discharge opening. At the same time, the seat of the ball valve will be cleaned before the trap returns to its filling position. Another advantage of the ball valve is that at successive operations it returns to its seat at a different point on its circumference, hence the wear is uniform and the ball tends to retain its spherical form. If it should be necessary, the ball valve can be taken out by removing the flange Q.

A valve of this form avoids such trouble as may occur with valve stem packings, the only parts of the trap that require packing being on the side flanges N and Q. Traps which have been in constant use for over a year working under pressure of 150 pounds have not required repacking, it is stated.

The traps are tested to 300 pounds steam pressure and are guaranteed to work satisfactorily under any pressure from 2 to 250 pounds, the same construction being used for all pressures. Any part of the trap can be easily removed and the whole trap may be taken apart and put together again in very short time. A noticeable point in the trap is the absence of pins, floats, small levers and valve discs. The movement of the trap when in operation gives constant evidence as to whether or not it is performing its function.

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The A. O. S. E. Convention.

The Annual Convention of the American Order of Steam Engineers will be held in Milwaukee, Wis., on the second Monday in June. The committee in charge of arrangements for the Convention are preparing to give the visiting delegates and their friends a rousing welcome and are doing everything possible to make the Convention the most successful in the Orders history. A large exhibit room has been engaged and the committee expects to have an extensive display of power plant equipment and engineers' supplies. The Convention proper will be held in Freie Gemeinde Hall, 262 and 264 Fourth St., which is convenient to the centre of the city. The exhibition room will be in the same building.

Headquarters for the delegates and others attending the Convention will be at the St. Charles Hotel, corner of Oneida and East Water St. Those desiring to engage rooms during the Convention can have their wants attended to by writing to the chairman of the committee.

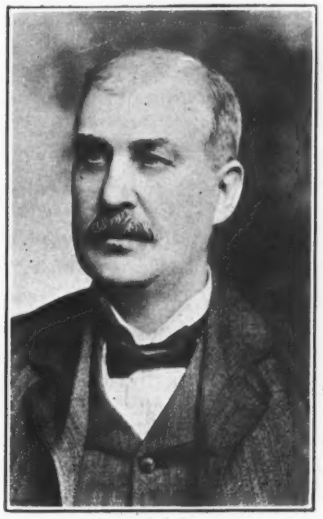
Those who wish space for exhibition purposes should arrange for it now, before all the choice locations are engaged. The committee will extend a broad invitation to all Milwaukee engineers to visit the exhibition hall during the Convention. A blue print showing complete plan of the exhibition floor, with the proposed arrangement of the various exhibits, will be sent to anyone upon request. For all information in regard to prices of space, etc., address, J. T. Harris, Chairman, 1611 Clybourne St., Milwaukee, Wis.

Pittsburg Engineers to be Licensed.

At last, after all these years, the engineers of the city of Pittsburg, Pa., are to be licensed. This is in conformity with an Act of the Pennsylvania Legislature passed and approved by the Governor, April 5, 1905. A complete account of this Act, with the full text of the law, was published in THE PRACTICAL ENGINEER for May, 1905. The law provides for the licensing of engineers in cities of the second- and third-class.

Otto G. Pillichody
Chief Boiler Inspector of Pittsburg, Pa.

The provisions of the law are about the same as the Philadelphia law. The operation of the law in Pittsburg has been delayed, awaiting the action of Councils, which was necessary in order to provide for its enforcement. All the preliminaries have now been completed and the law will go into effect at once.



John W. Anderson
Assistant Boiler Inspector of Pittsburg, Pa.

The Chief Boiler Inspector will be Otto C. Pillichody, and John W. Anderson will be first assistant. They will be located at 431 Sixth Ave., on the third floor of the Public Safety Building and will receive salaries of $2000.00 a year and $1500.00, respectively. Mr. Pillichody is one of the best-known engineers in Pittsburg and his selection for the new

position is sufficient guarantee that the law will be rigidly and conscientiously enforced. Mr. Pillichody is Past-President No. 52, N. A. S. E., Ohio; Past-President No. 95, I. U. S. E., Pittsburg; Past-Treasurer Ohio Society of Mechanical and Electrical Engineers, Worthy Chief of Universal Craftsmans' Council, No. 11, of Pittsburg, and member of Steubenville Commandery, No. 11, Knights Templars.

John W. Anderson, who has been appointed Assistant Inspector, is 56 years of age and has been connected with the business from boyhood, his father before him having been engaged in the same profession.

His first engagement was with the Cadman & Crawford Brass Foundry Co., a pioneer Company in the brass industry in Pittsburg. He was then engaged in the river coal business on the Ohio River, making several trips to Louisville, Cincinnati and New Orleans.

In 1882, he accepted a position with J. Painter & Sons, as engineer, which he held until two years ago, when he resigned to accept the office of Business Agent for Local No. 95, of the International Union of Steam Engineers.

His long experience in the profession should well qualifiy him for the position to which he has been appointed.

Book Reviews.

Electric Power Transmission, by Louis Bell, Ph. D. Fourth Edition. Size, 6 x 9. 18 chapters, 720 pages and 340 illustrations. Published by McGraw Publishing Co., 114 Liberty St., New York City. Price, $4.00.

When this book was first published in 1897, it filled a long-felt want and it gave to the engineering world an accurate knowledge of the scope and application of electric power transmission, which up to that time had never been brought properly to the attention of the practical man, owing to the wonderful strides that were being made in electrical application. From that time up to the present, there have been many changes in the transmission of power, especially in the kind of voltages and in the improvements in station accessories and line construction.

The fourth edition of this book has shown that Dr. Bell has kept up with these changes and as it appears at present it contains the latest methods of electric power transmission and description of the types of apparatus used therewith.

The book is written in a clear manner, there being very little mathematics used to confuse the reader. Starting out with the elementary principles and general conditions of power transmission, the contents include power transmission of continuous currents, properties of alternating current circuits, power transmission by alternating currents, alternating current motors, current reorganizers, engines and boilers, water wheels, hydraulic development, organization of a power station, auxiliary and switchboard apparatus, line construction, methods of distribution and high voltage transmission.

The book is clearly illustrated and contains a number of useful tables.

Telephone Wiring, by James F. Fairman. Pocket Book Size, with flexible leather cover. 90 pages and 75 illustrations. Published by McGraw Publishing Co., 114 Liberty St., New York City.

This book is written as a guide to telephone men and contains besides a description of the action of the telephone receiver and transmitter, numerous diagrams of circuits for straight lines, party lines, plans, sub-stations, private lines and intercommunicating systems and the rules of the Fire Underwriters governing telephone system.

This book should be very handy and useful to the practical man working around telephones.

The N. A. S. E. Convention Committee Hustling.

The next Convention of the N. A. S. E., which will be held in Philadelphia, promises to far outshine any of its predecessors, if the predictions of the Local Committee come true. This Committee has been hustling during the past three months, perfecting arrangements for the comfort and enjoyment of those who will attend the Convention. They have engaged Horticultural Hall, one of the finest and most centrally located in the city, for the meeting place of the Convention and for the display of the Supplymen's exhibits. The hotel headquarters have not been decided upon definitely, but as there are a number of hotels adjacent to the Hall, at least two of these will be selected. It is also contemplated to engage one of the largest theatres nearby for the holding of the opening exercises.

The Convention Committee consists of Richard Pape, V. L. Rupp, Ernest C. Fox, Enoch Carless, Albert Winthers, Ebenezer Carless, James S. Gillespie, Chas. W. Snyder, Chas. E. Coburn, G. Frank Duemler, R. E. Calvert, John Gaskill, John Buggy, Charles Rostron and John Carrington.

Lehigh Council.

The members of Lehigh Council, No. 15, A. O. S. E., of Allentown, Pa., are making renewed efforts to have City Councils pass a bill creating the office of Boiler Inspector and providing for the licensing of engineers in conformity with the Legislative enactment approved April 5, 1905, which Act authorizes cities of the second- and third-class to enforce the licensing of engineers. It is believed that Councils will approve the measure.

Lehigh Council now has 121 members, which makes it one of the largest engineer organizations in the State. At a recent meeting a committee was appointed to suggest subjects for discussion at the meetings and to promote the educational work of the Council.

A New N. A. S. E. Association Formed.

The Charles H. Garlick Association, No. 10, of Penna., was added to the ranks of the N. A. S. E., on March 3d. It was instituted by Chas. H. Garlick and Messrs. Wilson, Conn, Dodds and McDermott. The Association has 49 charter members, of whom 29 were present at the opening meeting. The following officers were elected: Past-President, David Ackard; President, James McGinnis; Vice-President, James McGregor! Treasurer, James R. Smith; Financial Sec'y, M. D. Lasher; Corres. Sec'y, H. V. Harwood; Recording Sec'y, E. R. Wangaman; Conductor, W. S. Dickey; Doorkeeper, H. P. Schall; Trustees, R. S. Kurner, James McGregor and W. C. McGinnis.

TRADE NOTES

EDITED BY THE ADVERTISING MANAGER

When the Peerless Rubber Company offers to send a souvenir to engineers, we all know that it is something worth while. The valuable pocket knives, leather wallets and other expensive souvenirs which they have passed out to the delegates at conventions for several years have given them a reputation for generosity hardly surpassed by any other house in the engineering field, therefore the announcement in their advertisement in this issue has a special value. What the souvenir is is not stated, but that it is something good goes without saying. See pages 37, 38, 39 and 40.

The Liberty Mfg. Co., 6409 Susquehanna St., Pittsburg, Pa., have just moved into their large new brick factory in which has been installed a lot of new machinery and tools of the most modern design, but even with the increased room and capacity, they inform us that they are not more than able to keep up with their orders for Liberty Turbine Tube Cleaners, Twin Strainers and famous Oil Filters.

The fly-wheel accident described in this issue is likely to remind both engineers and manufacturers that an automatic engine stop is just as much of a necessity in the life of an industrial establishment as is an insurance policy on the life of an individual who wishes to protect his family against disasters. The Locke Regulator Co., Salem, Mass., issue a very fine catalogue illustrating the Locke Automatic Engine Stop and Speed Limit. They will mail a copy to anyone mentioning THE PRACTICAL ENGINEER.

"Elevators are trolley cars that go up and down, but sometimes they don't," explained a little tot used to visiting its father's offices on the steenth floor of a sky-scraper. When they don't "go up and down," there is trouble for some one—usually the engineer—and unless he has competent assistants, they may do more harm than good. These facts were discovered long ago by a few men who had spent years in the elevator business and it occurred to them that most people who have elevators would be glad to get rid of the repair troubles, so they started the Keystone Elevator Inspection and Repair Co., which is now located at 923 Locust St., Philadelphia, and which is probably the largest concern of the kind on the Continent. They have a large force of expert elevator men and portable tools of the latest and best design, and what's more—they are always ready when you have elevator troubles. Send for them!

C. A. Dunham Co., Marshalltown, Iowa, have issued a new circular describing their various styles of Steam Traps. These may be had upon request made to Mr. L. B. Mellor, 14 South Fourth St., Philadelphia, Pa.

The C. H. Wheeler Manufacturing Co., Lehigh Ave. and 18th St., Philadelphia, have just published a new catalogue which should be in the hands of every engineer who is interested in condensers or air pumps of any kind or for any service. It describes the Wheeler-Millan apparatus very comprehensively and illustrates numerous combinations adaptable to various purposes. The illustrations are so instructive that no man who has to do with condensing apparatus can afford to be without a copy of it. It also describes the Wheeler-Pratt Water Cooling Apparatus, both in single unit and in battery, and with natural and forced draft. The unique style of this catalogue makes it a distinct novelty in engineering literature, all of the illustrations being in blue print. The size of the page is 7 x 10 inches, with a richly embossed cover. When writing for a copy, ask for Bulletin No. 8 and mention THE PRACTICAL ENGINEER.

MR. O. J. GARLOCK
Inventor of Garlock Packings and President of the Garlock Packing Co., in his Latest Auto.

The "Exacto" Packing Gauge and Cutter is a new device for cutting coil packings so that they will exactly fit the rod. It is unquestionably the best thing of the kind that has ever been offered to packing users and will be hailed with delight by engineers everywhere. The cost is trifling in comparison with the great saving in both labor and packing and no packing user can afford to be without it, even for a day. For descriptive booklet and prices, address, Green, Tweed & Co., 109 Duane St., New York City.

The American Water Softener Company, 1002 Mutual Life Building, Philadelphia, report a large increase in the number of inquiries received for their water softening and purifying plants. This Company did the largest business in their existence during the year 1905 and on the prospects shown by the opening months of 1906, base their expectations of doing an even larger business this year.

A contract has just been awarded to the Corliss Engine Works, 4041 N. Fifth St., Phila., to furnish two 18 x 32 inch Rickards Corliss steam engines for the Southern Manual Training School, Broad and Jackson Sts., Phila.

ANNOUNCEMENT.

There has been some confusion and delay in the transmission of mail matter and orders intended for this Company, owing to some similarity between its corporate title, the C. H. Wheeler Condenser and Pump Co., and that of another concern. In order to avoid a recurrence of such confusion and delay, it has been decided to change the corporate name (to take effect March 1, 1906) to C. H. Wheeler Manufacturing Company.

It is rumored that the Automatic Refrigerating Company, of 22 Thames St., New York, which Company, it will be remembered, represent the merged interests of the Automatic Refrigerating Co., of Cleveland, Ohio, the Singer Automatic Ice Machine Co., of Bridgeport, Conn., The Marshall Ice and Refrigerating Machine Co., of Boston, Mass., is about to remove their office, shop and refrigerating show plant to Hartford, Conn., where provision has been made for greatly-increased manufacturing facilities.

The Automatic Company occupies a rather unique position in the refrigerating field, in that it makes a specialty of small equipment for which most of the two hundred odd manufacturers of refrigerating and ice-making machines do not care to bid.

When the season for heating buildings closes and some of the difficulties and the expensive leaks have been discovered, it will pay some engineers to look into the uses of the Knight Receiver and Oil Separator, built by Walter J. McKnight, 179 Washington St., Buffalo, N. Y.

In order to better accommodate their rapidly-growing business, Green, Tweed & Co., of New York City, have removed to much larger quarters at 109 Duane St., where they will be pleased to see any of their old friends and patrons.

Rarely does the trade obtain such a chance of becoming posted on Steam Separators as is given in a 16-page booklet (with 10 attractive illustrations) recently issued by the Ohio Blower Co., 43-47 Michigan Ave., of Cleveland, Ohio.

This booklet on "How a good Separator works" is worth a whole lot to the man anxious to be inculcated with advanced ideas.

This Separator is the outcome of years of tedious and expensive experiments made by its inventor, Mr. D. K. Swartwout, from whom it takes its name, and as it is a separator that does the work honestly, simply and effectually, it is fast becoming as popular as it is profitable, because true merit always wins out.

As a suggestion, we advise everyone interested in power plants to obtain a copy of this "What a Good Separator Does" booklet, by writing to the manufacturers, The Ohio Blower Co., 43-47 Michigan Ave., Cleveland, Ohio.

Bridgman Bros. Co., 1422-26 Washington Ave., Philadelphia, have added another large new warehouse and are now carrying a complete stock of the celebrated Richardson boilers and also a full line of the Radiators made by the National Radiator Co., Johnstown, Pa. Mr. Frank C. Eckfeldt is in charge of this department.

McLeod & Henry Co., Troy, N. Y., have opened a Philadelphia office at 1518 Arch St., with Mr. Frank H. Waite in charge. This Company are the manufacturers of the famous "Steel Mixture" Boiler Door Arches and Fire Box Blocks tongued and grooved. Also Foote's Back Arch, all of which are said to be giving splendid satisfaction wherever used.

"Roofing Rules" is the appropriate title of a new hand-book on sheet metals in building construction, for architects and engineers, just issued by Merchant & Evans Co., 517 Arch St., Philadelphia. It discusses very fully the various materials used for roofing; tells the advantages of metal over slag, gives the weight of various roofing materials, etc. If you need a roof over your head, or ever expect to, this book will help you. It's free.

The Homestead Valve Manufacturing Co., Homestead, Pa., have issued a new schedule of discounts and price list covering their complete line of valves, a copy of which will be mailed to those interested, upon request. The well-known and reliable Company now have an unusually complete and well-equipped brass foundry and are prepared to make all kinds of special brass castings for any one desiring work in that line.

F. A. Genth, Jr.

Analytical and Consulting Chemist

222 WALNUT STREET

Telephone **Philadelphia**

AN ENFORCED ENLARGEMENT.

The inevitable, unvarying result of making any supremely excellent article of universal demand and of making its virtues well and widely-known to the inhabitants of such a country as ours, is a constantly-increasing demand for that commodity—no matter what it be. The sun shines on no other land wherein the habits and traditions of the past are so quickly discarded in favor of advanced methods and improved appliances as in this favored land of ours, with its eager and persistent searchers after, and prompt adopters of, "something better." No better illustration of these "conditions," for such they most certainly are, can be found than in the recently enforced expansion of the already large and well-equipped manufacturing facilities of the Main Belting Company, at Philadelphia. This ever-enterprising Company has built, on the very latest and most-approved lines, an addition to their plant which will very greatly increase its output and enable it to at least measurably keep pace with a demand for its Leviathan belting —as its altogether unique, wear-resisting powers become more widely known. The Leviathan Belt has long since won, and is ever winning for itself, many new openings for the display of its consummate driving capabilities, and in manifold and various duties as a conveying and elevating medium is demonstrating its astonishing "fetch-and-carry" capabilities. To its utter insensibility to conditions that prohibit the employment of leather belts and that speedily wreck rubber belts may be credited the already great and ever-growing popularity of Leviathan belting with the class of users who insist upon "results first, last and all the time." Leviathan belting, made only by this Company, is successfully run exposed to heat, cold, wet, grease or grime, flying sparks, etc., and in its make-up combines great tensile strength with the lithe pliancy of a serpent—a combination that imparts to it such a powerful grip on the pulley that the full quota of power is frequently secured with a belt running slack. Prepared expressly for the purely practical man with small inclination for, and less time to, waste on inflated treatises, the Main Belting Company issue a small booklet which treats of the make-up and capabilities of their output, which booklet they inform us they will be pleased to send by mail to any of our readers who desire to investigate the claims of this remarkable power transmitter. Address, 1219 Carpenter St., Philadelphia.

For Sale The Process and Formula for Manufacturing Granual and Plastic Metallic Packing. **No Machinery required. Babbitt Ladle. Babbitt Metal and Graphite. That is all.** Ideal Metallic Packing Co , 419-421 MacKubin St., St. Paul, Minn.

I want a position as engineer of water works in a small city or town, have had long experience and can give splendid references Now holding a position. F C. B. S. Care of The Practical Engineer

Position wanted as engineer or electrician, in Idaho, Montana or Washington. O. J. G. care The Practical Engineer.

Wanted A few good and competent engineers along the Ohio, Mississippi and Kanawah Rivers, to sell the best thing on earth. This can be done after working hours and between times. Address, J. L. TILLMAN, 521 Colburn Street, Toledo, Ohio.

Wanted Salesmen traveling among engineers to sell the France Metallic and Fibrous Packings. Good inducements on unoccupied territory, Address
FRANCE PACKING Co., Tacony, Phila., Pa.

PATENTS Watson E. Coleman, Patent Attorney, Washington, D. C. Advice free. Terms low. Highest ref.

PATENTS Procured ISEDORE S. PRENNER, E.E. Attorney-at-Law, Solicitor of Patents, Consulting Engineer, Law, Patent and Engineering Cases.
Room 1108 Betz Building, Philadelphia.

PATENTS PROMPTLY SECURED. Highest references from prominent manufacturers. Write for Inventors' Hand-Book, SHEPHERD & PARKER, 186 Deitz Building, Washington, D. C.

GRAPHO
SOMETHING NEW
A new preparation for enriching oils.
Will suspend in oil.
No more Hot Journals.
Engineers who have tried same claim it to be the best yet.
SEND FOR SAMPLE
A trial will convince you
AGENTS WANTED
GRAPHO MFG. CO.
Cor. Frank and Commercial Sts.
ROCHESTER, N. Y.

The new No. 10 Catalogue, issued by the Wright Mfg. Co., 72 Woodbridge St., Detroit, Mich., will prove especially interesting to every engineer who is interested in the care and operation of steam traps for either high or low pressure. A special feature of this latest catalogue of the Wright Company is the large number of recent testimonial letters from satisfied users, many of which describe specific difficulties that have been remedied by the use of the Wright trap. Another good feature is the revised tables of capacities. Copy of catalogue will be mailed upon request.

All the ice water, hot salt, hot fresh water and steam heating pipe covering, as well as the power piping in the boiler room of the big new Marlborough-Blenheim Hotel, at Atlantic City, is being done by John R. Livezey, 1936 Sansom St., Philadelphia.

The catalogue of Richard Thompson & Co., 126 Liberty St., New York, will be of value to anyone interested in Indicators, Reducing Wheels, Planimeters, etc. This firm also manufacture the Thompson Damper and Pressure Regulator, Thompson's Patent Soot Ejector for removing soot from boiler flues without blowing steam into the flue. Also Shaking, Dumping and Stationary Grate Bars. A copy of the Thompson catalogue will be sent gratis to any reader of this Journal.

We Manufacture Durable Exhaust Heads

Akron, Ohio, Sept. 25, 1905

THE BURT MANUFACTURING CO.,
AKRON, OHIO

GENTLEMEN :—

We are in receipt of your esteemed favor of the 18th, and in reply, we are glad to say that the exhaust head which your superintendent, Mr. Maranville, made for us when we erected our Twine Plant sixteen years ago, is still in operation, is giving good satisfaction, and judging froma ppearances, it is still good for many more years of usefulness.

Yours very truly,
C. J. CANFIELD, Superintendent Twine Mill

The Ridgway Dynamo and Engine Co.

Is a concern which is satisfied only with the best of every sort of equipment. This letter, then, should carry conviction :

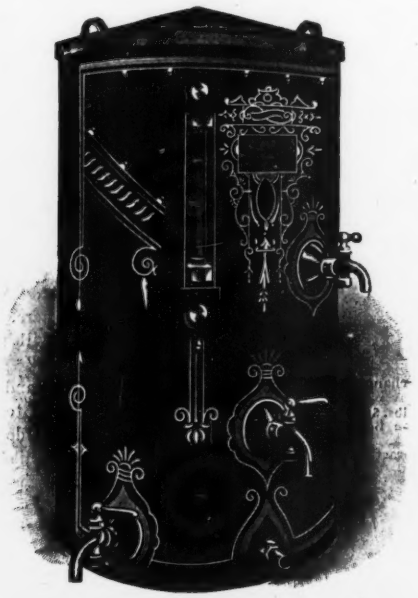
Ridgway, Pa., July 5th, 1899

THE BURT MANUFACTURING CO.,
AKRON, OHIO

GENTLEMEN :—

Replying to your inquiry as to the value of your filter, one of which we bought a few months ago, would say that we find that by its use we can save a great deal of oil. We use oil quite liberally in testing engines and since we put in this filter we have not used a gallon of new oil on our testing block and have effected a great saving. Where we have an opportunity we recommend the use of a filter to any user of engines of 30 H. P. and upwards, and so far as our observation has gone we have found nothing better than yours on the market.

Yours truly,
RIDGWAY DYNAMO & ENGINE CO.
A. H. BELL, Superintendent



An oil filter that will effect a 50 per cent. saving in your oil bill is a bit different from the ordinary. We have recently issued a 48 page catalogue describing our various Oil Filters and Exhaust Heads and will be glad to send a copy to any engineer upon application.

The Burt Mfg. Co.

Largest Manufacturers of Oil Filters in the World.

204 Main Street, AKRON, OHIO, U. S. A.

Also Supplied by Engine Builders, Dealers, and Power Contractors

Carried in stock by Shelby & Co., 66 Leonard Street, London, E. C., England, Sole Agents for Great Britian.

The "Demon" and "Torpedo" boiler scale removers, illustrations of which will be found in the advertising columns of this paper, are having a very large sale. The "Demon" is rightly named, for it is claimed by the manufacturers that its great power enables it to bore through any thickness of scale. In fact, it is so powerful that its action is more of a crushing action than anything else. It is claimed that this machine is so designed that it is impossible for the operator to force it to pass over any scale, or otherwise the machine refuses to advance in the tube.

The "Torpedo" fire-tube boiler employs the best mechanical principles known. It does not hammer the tubes, but produces a very rapid vibration. In fact, the manufacturers claim that a recent test has shown that it produces over 11,000 vibrations per minute and with no strain on the tube itself. The machine is so simple that it has but one moving or wearing part. The General Specialty Company, who manufacture the above cleaners, issue very interesting, illustrated, descriptive matter on their machines, which will be sent free on request. Their address is 75 Carroll St., Buffalo, N. Y.

The Canfield Mfg. Co., 116 Lehigh Ave., Philadelphia, are again offering to send a sample can of "Ambest" Packing, free of charge, to readers of THE PRACTICAL ENGINEER. See advertisement on page 70.

McLeod & Henry Co., Troy, N. Y., manufacturers of Steel Mixture Boiler appliances, have opened an office at 1402 Broadway, Room 1125, Knickerbocker Building, New York City. John H. Foote, Manager.

Mr. John R. Livezey, of Philadelphia, the man who has made Nonpareil Cork famous for pipe covering and other insulating purposes, has gone to Florida for a few weeks' rest. Mr. Livezey says he will spend considerable time in fishing, and we presume he will have a cork on his line. He left on March 18th and he expects to return some time in April.

The Dunham Steam Trap is a very small trap with a very large capacity. It is of unique design and said to give good satisfaction under the most trying conditions. A circular which illustrates it very comprehensively and describes its construction and operation in detail will be mailed to anyone mentioning this paper. Address, C. A. Dunham Co., Marshalltown, Iowa.

The science of boiler setting and furnace brick work is perhaps better understood by the firm of W. H. H. Taylor & Son., 119 South Fourth St., Philadelphia, than by any other concern in this country. This firm have made a specialty of this class of work for many years and have shown marked ability in overcoming obstinate conditions. Elimination of black smoke and economy in fuel are two of their specialties.

In the description of the power and lighting plant of the New York Stock Exchange, published in our March number, we omitted to state that the plant is equipped throughout with Sterling Force Feed Lubricators, some thirty of these popular lubricators being in service there and giving highly satisfactory results. Another important New York building which has recently installed seventeen Sterling Lubricators is the New Barclay Building, on Broadway. This order was placed after an exhaustive competitive test, covering a period of several months. Several kinds of lubricators were placed on the different engines and pumps, and after a thorough working trial, it was decided to adopt the Sterling throughout the entire plant. Both the Stock Exchange and the Barclay Building were previously equipped with an elaborate and expensive automatic oiling system which has been discarded in favor of the force feed system. Sterling Lubricators are made by the Sterling Lubricator Co., 3 Frank St., Rochester, N. Y. A catalogue describing them will be mailed to any reader of THE PRACTICAL ENGINEER, upon request.

At the annual meeting of the Stephenson Mfg. Co., of Albany, N. Y., on March 6th, W. E. Milbank was re-elected president; E. A. Kellogg, vice-president and treasurer, and K. L. Waterhouse, secretary. This Company manufactures Stephenson Bar Belt Dressing, which is known by every engineer in America, and which has been advertised so extensively and attractively that a healthy and world-wide demand has been created for it. The Company now have a large four-story factory in Albany and sufficient ground room to build a large addition thereto. Engineers who have never used Stephenson Dressing can procure a sample bar by writing the Company.

SECOND - HAND MACHINERY

IMMEDIATE DELIVERY

In Stock. Rebuilt and Guaranteed.

ENGINES.

1—28" x 60" Wetherill Corliss, Rolling Mill Type.
1—28" x 48" Cooper Corliss.
1—26" x 60" International Engineering Co.
1—18" - 34" x 36" Cross Compound Fitchburg.
1—16" x 36" Double Fitchburg Automatic Engine.
1—22" X 42" Allis Corliss.
1—18" x 42" Watts Campbell Corliss.
1—17" X 36" Greene.
1—16" - 27" x 16" Westinghouse Compound.
1—12" - 20" x 12" Westinghouse Compound.
1—12" - 22" x 20" Porter-Allen.
1—12" - 20" x 16" McEwen center-crank.
1—16" x 16" Ball & Wood Automatic.
1—16" x 16" Greene.
1—15½" x 15" Armington & Sims Automatic.
1—15" X 16" New York Safety.
1—15" x 30" Buckeye Automatic.
1—15" X 28" Russell, Four (4) Valve, Automatic.
1—15" X 18" Taylor-Beck, Automatic.
1—14" X 20" Russell, Four (4) Valve Automatic.
1—14½" x 15" Armington & Sims Automatic.
1—14" X 24" Payne, Four (4) Valve, Automatic.
3—14" X 13" Armington & Sims.
1—13" x 22" Buckeye Automatic.

And many others. Stock is constantly changing.

BOILERS.

Two (2) 150 H.P. Vertical Manning Boilers, 135 lbs. Steam.
One 250 H.P. Babcock & Wilcox Water Tube Boiler, 150 lbs. Steam.
Two (2) 180 H.P. National Water Tube, practically new.
2—72" diam. X 18' Horizontal Return Tubulars.
6—66" diam. X 18' " " "
2—46" diam. X 16' " " "
1—60" diam X 18' " " "

All first-class high pressure.
Steam Pumps up to 12" Suction.
Full assortment of Gas and Gasoline Engines.
Largest assortment of Dynamos, Iron and Wood-Working Machinery.

FRANK TOOMEY

127-131 N. Third Street, Phila., Pa.

Mr. L. L. Bentley, M. E., formerly with the Lehigh Valley R. R., is now general manager of the Oswego Boiler and Engine Co., at Oswego, N. Y., who now have one of the best-equipped plants in the East for boiler stack and tank work. It is equipped with complete hydraulic and air tools, including flange press and two riveters, a foundry and ample machine shop facilities.

I. P. Morris & Co., of Philadelphia, Pa., have just published their latest technical bulletin for the use of consulting hydraulic engineers and those desiring information concerning the variation in power and efficiency of a turbine wheel, when running at a constant number of revolutions and operating under varying heads of water. The information contained therein will be found interesting and valuable to those contemplating the utilization and development of water power and also to those making a study of the economic running of water wheels.

The data published in the bulletin is based upon the results of tests of wheels built and installed by I. P. Morris & Co., and are applied to the preliminary design of a 13,500 horse power water wheel, working under variable heads of from 50 to 70 feet running at the constant speed of 107 revolutions per minute.

THE FIRST TRAIN DISPATCHER.

Mr. A. H. Copeland, who for nearly thirty years was agent for The Chicago & Alton Railway at Chenoa, Illinois, claims to be the first man who ever dispatched a train by telegraphic train orders. When the event took place, in the early fifties, Mr. Copeland little dreamed of the far-reaching result of a simple act of kindness.

It came about in this way: In the winter of 1852, Mr. Copeland worked in the post office at Middlebury, Vermont, and was also telegraph operator, the telegraph offices in those days being generally located in the post offices and not in depots. Railways had no telegraph service of their own; the trains were operated wholly by time-card rules which provided that one train would wait at a certain station until the other train had passed. If one train was late at the meeting point, the other was required to wait twelve hours or until the other showed up. Such a condition existed on the winter morning in February, 1852, when the first telegraphic train order flashed over the wires.

It read something like this: "North bound train in snowbank south of here. You come on down to Rutland and I will not let any train go north until you arrive." Mr. Conductor read his order, looked Copeland straight in the eye and said: "I am afraid to do this. I might be taking a chance. How do I know it's genuine?" Copeland quietly replied: "I'll ride on the engine to Rutland." That settled it, and the train went on its way, the passengers rejoicing and heartily thanking the operator.

It was not until 1868, years after all this, that Copeland went to the Chicago & Alton, where he found in full effect the perfected result of his original and accidental use of the telegraph in the movement of railway trains.

ENGINEERS, ATTENTION!

ON the following two pages you will find a reproduction of the "PEERLESS" Exhibit of

ENGINEERS' RUBBER SPECIALTIES.

The goods bear numbers running from one to thirty-one.

Send us a correct list of the various names of the goods numbered and **we will send you a first-class Gauge Glass Cutter,** which will last you years.

If you have not got a "Peerless" Engineers' Specialties Catalogue, write for one.

Put the name of the goods as illustrated and numbered in the following form:

1.....
2.....
3.....
4.....
5.....
6.....
7.....
8.....
9.....
10.....
11.....
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28.....
29.....
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31.....

When filled in return to

DEPARTMENT "C,"

PEERLESS RUBBER MANUFACTURING CO.

16 Warren St., NEW YORK.

THIS FLOOR IS LAID WITH THE FAMO PEERLESS

THE PEERLESS RUBBER

16 WARREN ST. N

FAMOUS PEERLESS SHEET RUBBER TILING

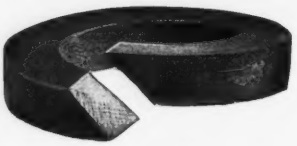
BER MANUFACTURING CO.

ST. NEW YORK.

BERNASCONI BROS. N.Y.

PEERLESS PISTON AND VALVE ROD PACKING

Made in Rings, With or Without a Core of the Celebrated Rainbow Packing Compound. Also made Straight, Spiral and Square Spiral.



Style 1.

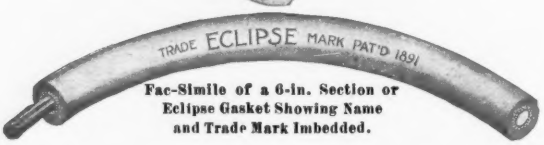
Style 2.

Style 3.

Style 4.

The celebrated Peerless Piston and Valve Rod Packing has many imitators but no competitors.

THE ECLIPSE SECTIONAL RAINBOW GASKET



Fac-Simile of a 6-in. Section or Eclipse Gasket Showing Name and Trade Mark Imbedded.

The most economical and convenient form for making Gaskets ever produced. Will carry in stock for years. Absolutely no waste.

Manufactured, Patented and Copyrighted Exclusively by

Peerless Rubber Manufacturing Co.

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Detroit, Mich., 24 Woodward Avenue
Chicago, Ill., 202-210 South Water Street
Indianapolis, Ind., 18 South Capitol Avenue
Louisville, Ky., 111-121 West Main Street
New Orleans, La., Cor. Common & Tchoupitoulas Streets
Omaha, Neb, 1218 Farnam Street
Richmond, Va., 1323 East Main Street
Philadelphia, Pa., 220 South Fifth Street
Dallas, Texas, 177 Elm Street
Memphis, Tenn., 228 Front Street

St. Louis, Mo., 1213 Locust Street
Denver, Colo., 1621-1639 17th Street
San Francisco, Cal., 17-23 Beale Street and 12-24 Main Street
Seattle, Wash., Railroad Way & Occidental Avenue
Kansas City, Mo., 1221-1223 Union Avenue
Waco, Texas, 709-711 Austin Avenue
Pittsburg, Pa., 634 Smithfield Street
Atlanta, Ga., 7-9 South Broad Street
Columbus, Ohio, Cor. Long and Third Streets
Cleveland, Ohio, 61 Frankfort Street

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CHIEF ENGINEER
M. B. SMITH COMPANY
SAGINAW, MICH.

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N. A. S. E.
Quaker City Council No. 6

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Charles Metzger

1017 Pine Street
San Francisco, Cal.

IF

You go to the Conventions
You go on a Vacation
You meet a Stranger
You will need these Cards.

You can get them FREE.

Cut out a piece of Scale from your boilers.
Cut out the coupon below and send to us with the Scale.

Write us exactly what you want us to print on the cards and which style.

Write plainly to prevent mistakes.

We will send you the cards absolutely free. Also a certificate of analysis of the scale, and some valuable pointers about

Lord's Boiler Compounds For YOUR BOILERS

GEO. W. LORD CO.
2238-50 N. 9th Street,
Philadelphia, Pa.

The Geo. W. Lord Co.
2238-50 N. 9th Street,
Philadelphia, Pa.

Gentlemen: I am sending you a sample of scale from our boiler. You are to analyze it, and send me, free of charge, a certificate of analysis and the Card

Number of boilers in use _____
Capacity of each boiler _____
Frequency of cleaning boilers _____
Frequency of opening the blow-off during working hours _____ *River or other source of water supply* _____
Boilers are used about _____ *hours out of 24*
Coal burned per day _____
Water evaporated per day _____
Name _____
Street and Number _____
City _____ *State* _____
Firm's Name _____
Date _____

April Prac. Eng.

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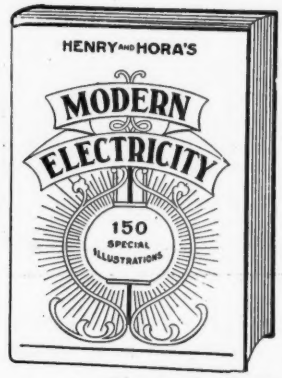

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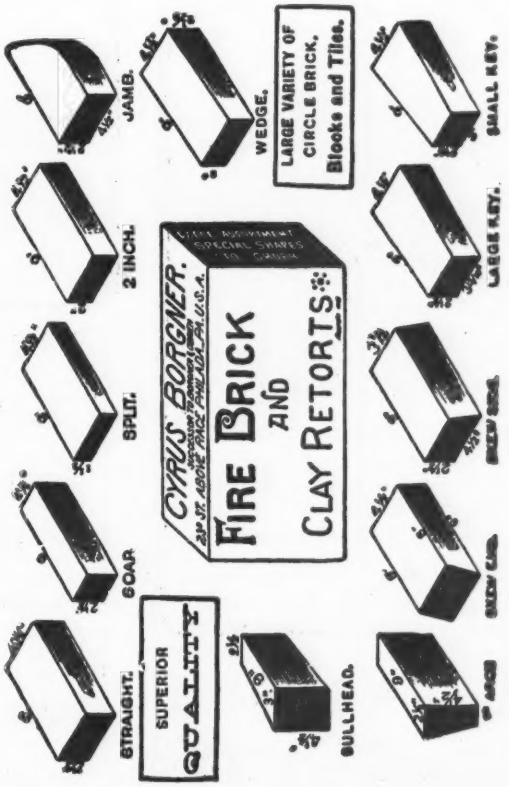

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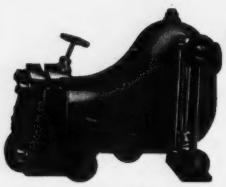

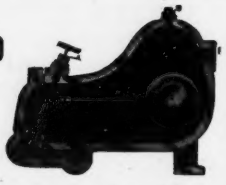

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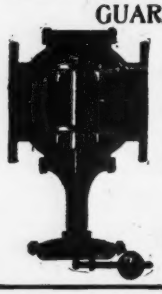

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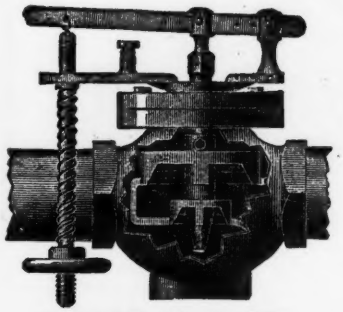

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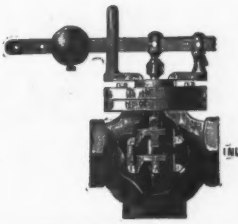

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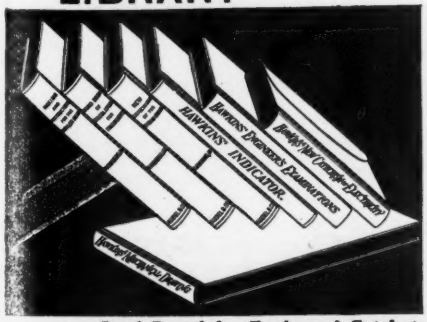

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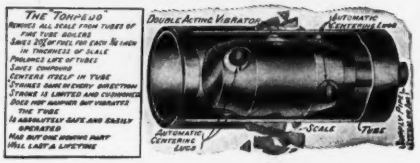
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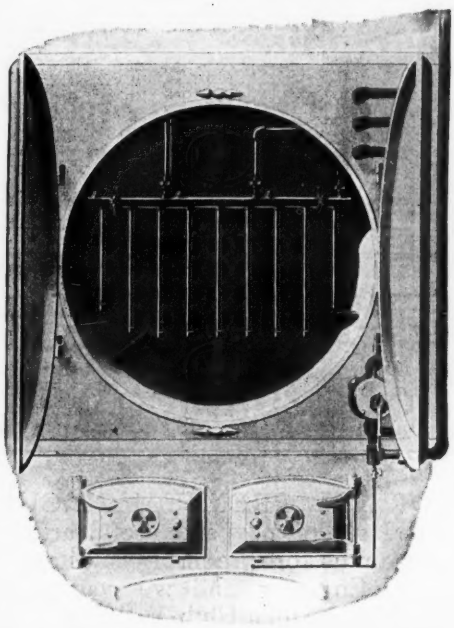

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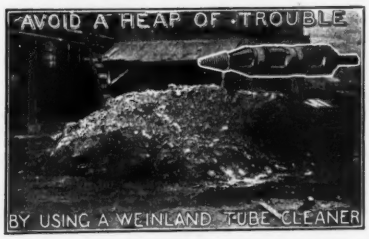

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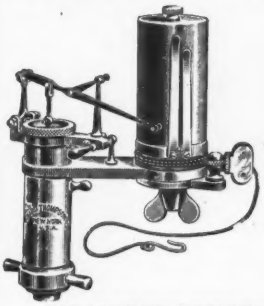

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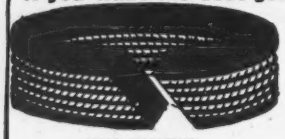

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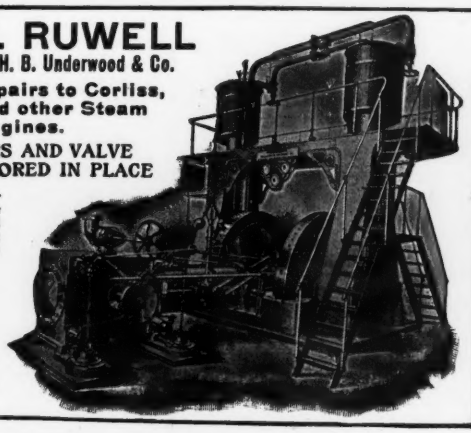

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Brass Founders and Finishers and Makers of Pop Safety Valves, Water Relief Valves, Oil Cups and Lubricators, Steam Pressure Regulators and other Safety Steam Appliances.
Old Kellam Regulators Repaired.
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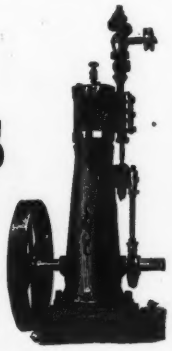

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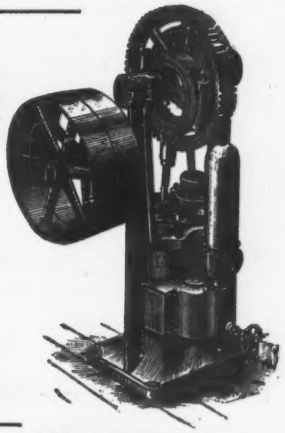

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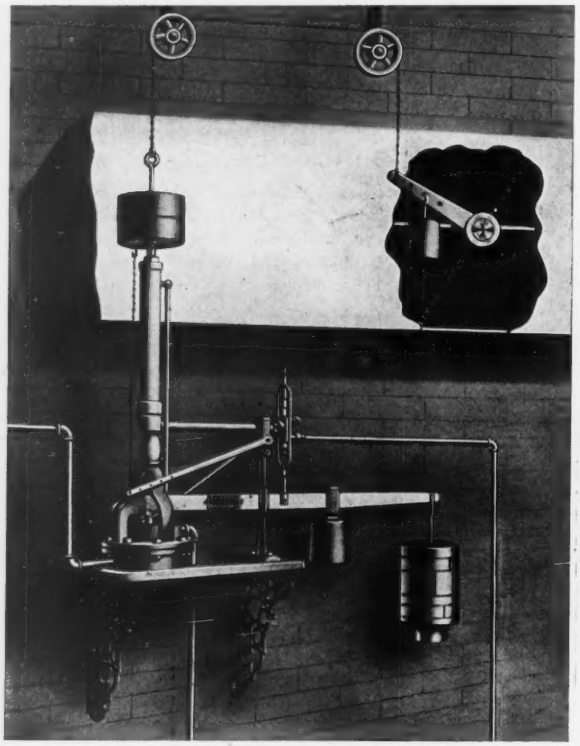

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Special Announcement

The first and only genuine Hydraulic Damper Regulator. All others are worthless imitations. Over 10,000 in use—152 sold to cotton mills in Fall River alone. Get our prices before ordering a mongrel. We warrant our machines for 5 years, and guarantee them for 20 years or your life time. They will outlast the boilers and entire steam plant.

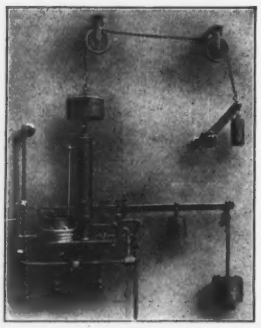
We Are Selling Them At Cost, so you need not waste any more money on cheap imitations. We have cut their prices and will give the public the benefit of this great invention. Their prices will look like a mountain when compared with our figures.

Write for cut prices on Damper Regulators. We make a tempting offer to the jobber and trade in general. Write to-day and get in on the ground floor before the rush.

Locke Regulator Company - - Salem, Mass.

$50.00

PATTERSON (PERFECTED) GRADUATED SCALE BEAM HYDRAULIC DAMPER REGULATOR (NO. 2 MODEL)



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Selling by Giving such Value as this for $50."

Scientifically Designed, Simple in construction.

Will handle 1 to 20 Dampers on (1) pound variation of boiler pressure.

Sent anywhere on 30 days trial.
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BEST HIGH-GRADE HIGH-PRESSURE PACKING

The toughest, most elastic and most pliable packing made. A few turns used in connection with any packing you now have will improve that packing greatly.

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WRITE TO ME AND ASK ABOUT IT

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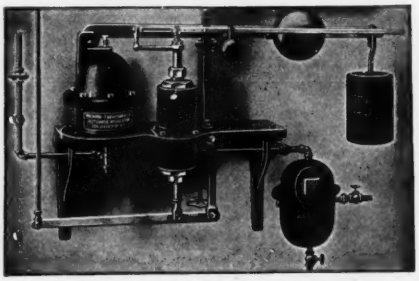

The Thompson Damper and Pressure Regulator is equipped with the very latest and best improvements, and positively insures uniform steam pressure, therefore it saves coal. Don't buy a regulator until you investigate the Thompson, it is the

MOST PERFECT ACTING REGULATOR MADE.

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The more violent the rotation of the steam through a Separator the better the separation.

In this Peer of Separators.

The Swartwout Vertical

The Separator without a fault—is found the practical illustration of the application of centrifugal force, as the steam rotates so violently through the helical worm that the water **must** remain, while the dry steam passes on.

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The United Supply Company, Saginaw, Mich.
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has won for itself a host of engineer friends all over the world. Men who know what is best and how to apply the best in their profession, that is the one and only reason Eureka wins, because they proved it best for past needs, best for present needs, best for the needs that so far the future presents.

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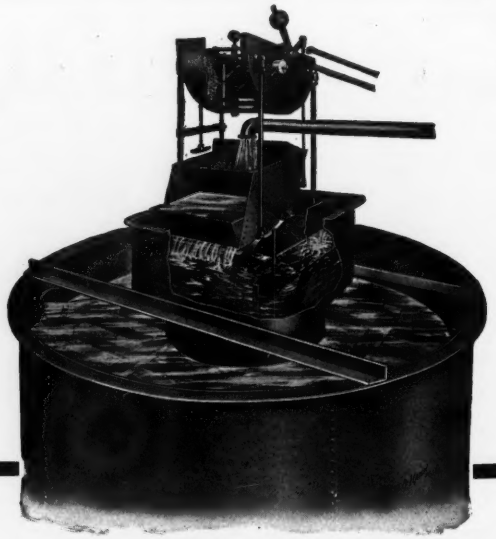

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Would you swallow poison because you know the Antidote?
Then why do you feed Hard Water to your Boilers?
Boiler Compounds and Cleaners are only Antidotes and a Boiler, to do its proper duties must first be rid of Poison and Antidote alike.

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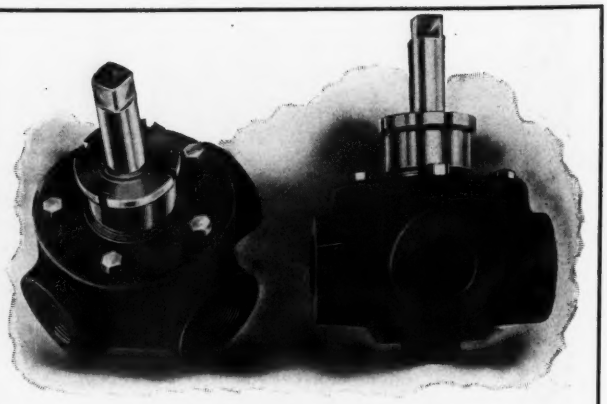

THE McCARTHY
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is used to take the place of the old four-way cock which as every engineer knows, wastes more steam than it takes to do the work required of it.

The McCarthy Valves have been in use for seven years under the most severe conditions and have never leaked. They are easy to work and require no packing.

They can be used to advantage for elevators, hydraulic and steam lifting machinery and are used extensively in all the largest iron and steel plants throughout this Country and Europe.

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YOU CAN SAVE NINETY PER CENT.

All boiler compounds are composed of approximately the same combination of chemicals. These chemicals can be obtained anywhere at a trifling cost and the mixing of them is a simple matter.

We will sell you the formula for making "Perfection Boiler Compound" and you can make it yourself and save about ninety per cent.

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never fails to give satisfactory results, we manufacture it for sale and guarantee perfect results or no pay. Those wishing to purchase the formula for making it may order a barrel of the compound first and test it before buying the formula. Write for circular and list of testimonial letters.

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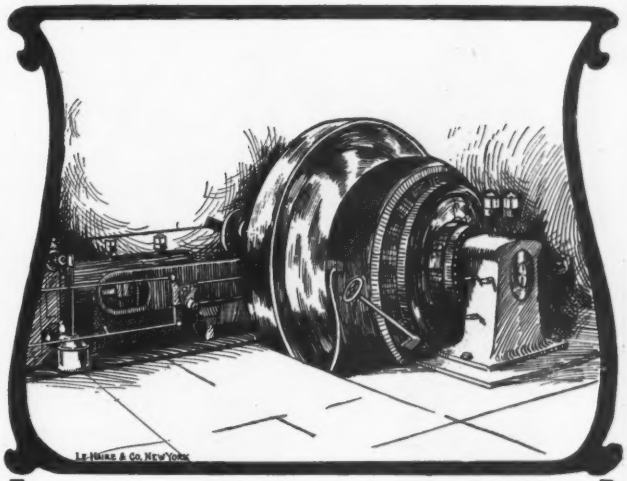

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Harris Electric Dynamo Oil

is specially prepared.

Free feeding, with all elements that could contribute to cause wear, corrosion or gumming absolutely eliminated, it is a superlative friction reducent. Notably durable under continuous operation at high speed, it possesses the important faculty of keeping bearings clean and cool, that is indispensable to dynamo and motor lubrication. Filtration fits it for repeated use, making it an economical as well as an efficient lubricant.

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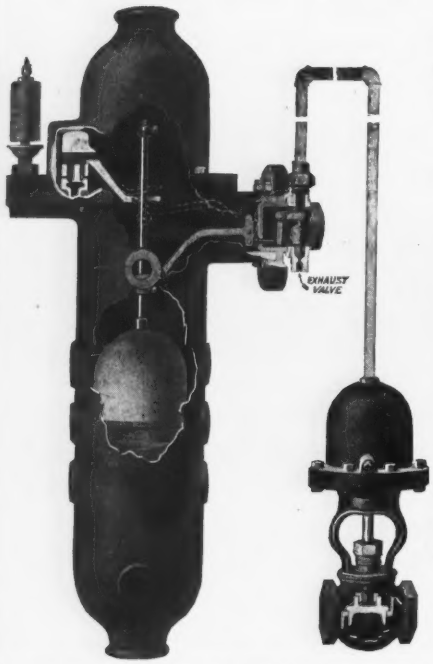
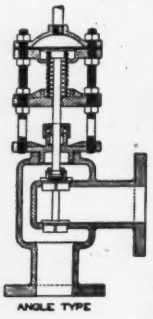
Williams Safety Feed Water Regulator

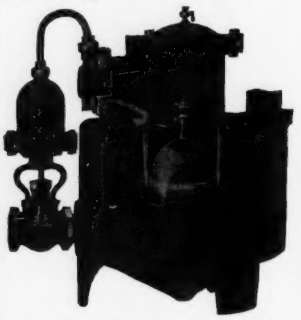
SAVES FUEL—SAVES BOILER—SAVES LIFE



Saves fuel by admitting the feed water regularly as required. Saves the boiler from unnatural strains by maintaining a uniform water level which cannot vary over half an inch either way; Saves life by preventing boiler explosions.

The Williams Steam Operated Trap has a greater delivery and a more positive discharge than any other trap. It blows the water out like a shot and closed just as quick. It will do the work of three or four ordinary traps and do it better.





The Williams Pump Governor is the biggest winner that has came out in the engineering field for many a day, since we first offered this governor to the public more of them have been sold than of all other makes combined.

OUR LARGE NEW CATALOGUE IS YOURS FOR THE ASKING.

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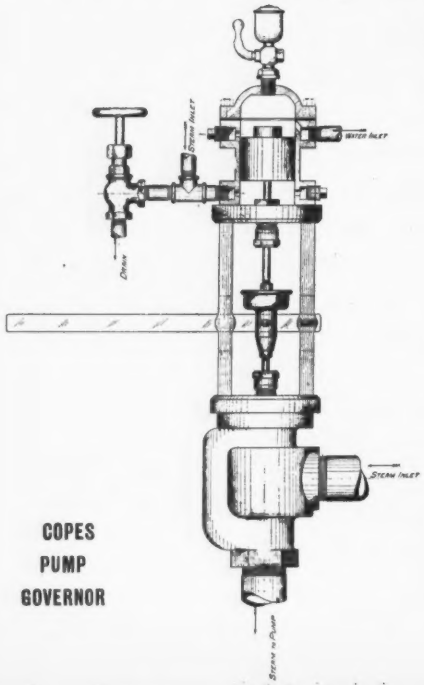
The Copes Pump Governor and Feed-Water Regulator



COPES PUMP GOVERNOR

will save you money in coal bills because it maintains a perfect water level.

It will save money in repairs because it gives a greater durability to the boiler.

It will save labor because it is positively automatic.

It cannot get out of order because

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FURNISHED ON 30 DAYS TRIAL

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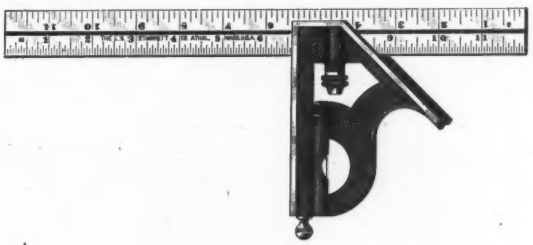

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The Practical Engineer

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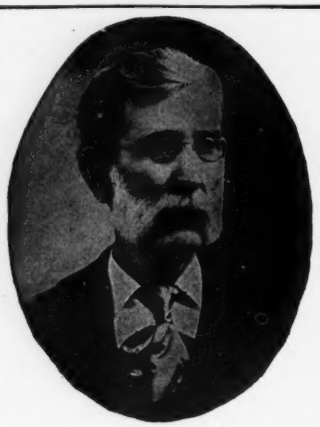

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Our compound is the result of years of experiments by an engineer of long experience, assisted by expert chemists.

American Boiler Compound not only completely removes all scale and incrustation in the boiler, but prevents new from forming, and will, if properly used, keep the boiler absolutely clean and free from all forms of corrosion, such as pitting, grooving, honeycombing.

Send sample of Water and Sample of Scale if Convenient.

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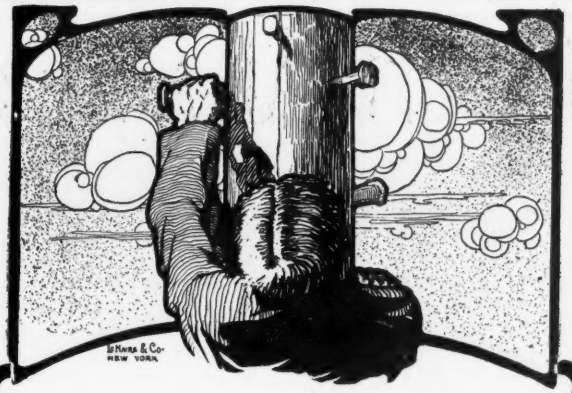

Move up a peg or two in your profession as an engineer. Buy a

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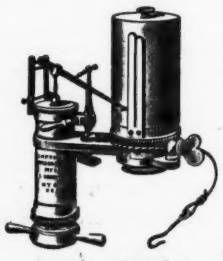

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consult it frequently and you will be more able, more confident, more efficient and there are 99 chances in a hundred that your present position will be too small to hold you, because you can command more pay and all that goes with it. Yet we sell Robertson-Thompson Indicators at a very reasonable price and on easy terms to engineers.

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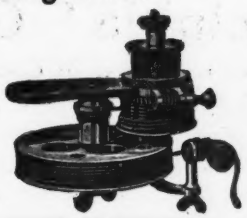
is always ready for any stroke or speed. The newly patented spring tension device does away entirely with the vexatious trouble from slack cord. We have them for every make of indicator.



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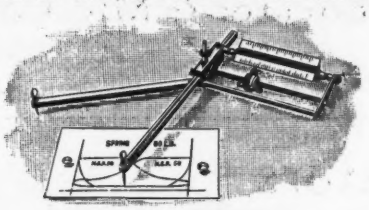

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enables you to avoid complex calculations and errors. You can get M. E. P. directly from the indicator card and it will be absolutely correct reading, without figuring. It costs less than you think.

All three are sold to engineers on easy terms.

Let us tell you about the saving in fuel where a Spencer Damper Regulator, Hine Separator, Robertson Feed Water Heaters and Eureka Packing are used. The experience of your acquaintances will convince you.

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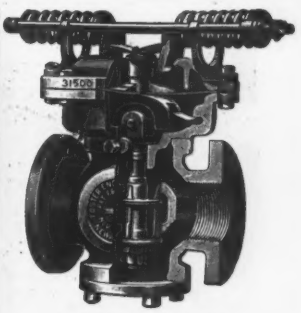
maintained at delivery from a higher initial pressure, regardless of variations in supply, by a



"Class W" Valve

Foster "Class W" High Pressure Regulator.

Ensures uniform delivery, at desired lower pressure, noiselessly, positively and automatically.

For pressures under 125 pounds, this is a standard device supplied in convenient sizes, of which a list is given in our catalog, describing this and other steam specialties.

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We have built up the largest educational institution in the world, with an invested capital of 5 million dollars and with ¾ million students, by helping people to increase their earnings. If we had not made a remarkable success of enabling people to earn more money, this remarkable growth would not have been possible. As an instance of what we can do for ambitious men engaged in mechanical trades, we quote the following:

When I enrolled in an I. C. S. Course, I was an assistant engineer earning $14 a week. Through the excellent instruction of my Course, I was enabled to advance rapidly until I am now in business for myself as a Consulting Engineer with a yearly income of about $10,000.
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Name _____

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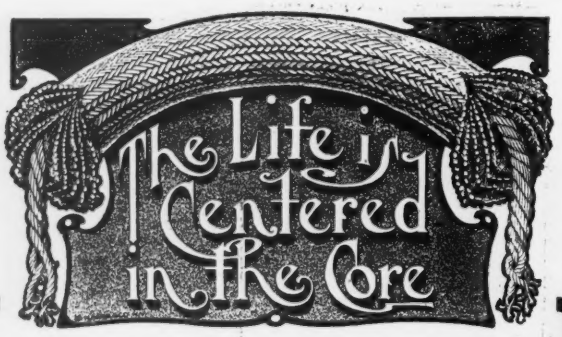

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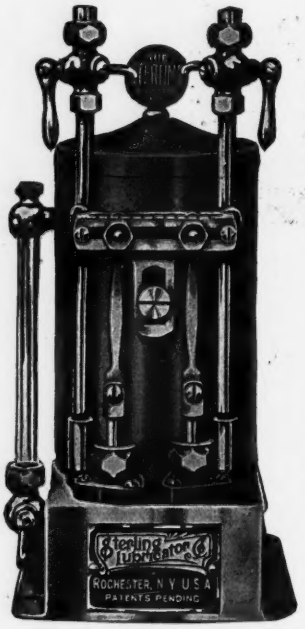
The reason why Palmetto Packing resists so well, the high pressures and high temperatures of to-day, is because we choose materials that are not affected by excessive heat and high pressure.

The life of Palmetto Packing, by which we mean, its springiness and its elasticity, is centered in the core. Examine the core of Palmetto Packing and you find it to be made of a number of strands of the same material that the packing is braided of, absolutely nothing to carbonize or grow hard, that is why Palmetto Packing lasts so long. Sample sent FREE.

Greene Tweed & Co.

17 Murray Street, NEW YORK

Experts All Agree



that a small quantity of oil is much better for machinery than a large quantity provided we can depend upon the small quantity reaching the bearing at regular intervals, but with the old style lubricators it has always been necessary to use two or three times as much oil as was actually required to do the work.

The Sterling Lubricator

is a perfect automatic machine it will feed regularly drop by drop just as much oil as is needed. There is no waste and no uncertainty, it gives perfect, positive lubrication with a minimum amount of oil. It is used in thousands of the best plants.

CATALOGUE FREE

Sterling Lubricator Co.

3 Frank Street, Rochester, N. Y.

The "Philadelphia" Grease Cup

Automatic Feed By Means Of Compressed Air

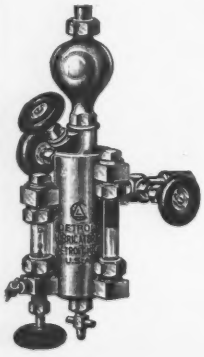
Geo. W. Barnett, Chief Engineer, East Orange (N. J.) Water Dept., reports running 192 hours with one and one-half ounces of grease in the "Philadelphia" Cup, as against 6 ounces to 8 ounces formerly used for same run in spring cup. Clear saving of at least 75 per cent. with just as good results.

We have many similar reports from other users of this Cup.

WRITE FOR FULL INFORMATION

The Philadelphia Lubricator & Mfg. Co., Inc.

1525 Land Title Building, - - Philadelphia, Pa.



The Detroit Lubricators

Are Standard the world over.

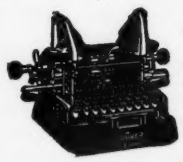
More than 850,000 of them are in use.

Look for the GENUINE ORIGINAL PACKAGE. Catalogue on Application.

Detroit Lubricator Co.

DETROIT, MICH.

YOU CAN EASILY OPERATE THIS TYPEWRITER YOURSELF



Don't worry your correspondent.

Don't write him anything by hand that akes him time to make out—that may leave him in doubt—that he can't easily read.

And don't fill out legal papers or card memos—or make out accounts in your own handwriting.

It looks bad, reflects on your standing, makes people think you can't afford a stenographer, and is sometimes ambiguous.

You can write out your letters—make out an abstract—fill in an insurance policy—enter your card memos—make out your accounts, or a hotel menu—or do any kind of writing you need, on any kind, size or thickness of paper, and space any way you wan on

The OLIVER Typewriter

The Standard Visible Writer

You can write any of these things yourself if you do not happen to have a stenographer.

For you can easily learn with a little practice, to write just as rapidly and as perfectly, as an expert operator on the OLIVER. Because the OLIVER is the simplified typewriter. And you can see every word you write. About 80 per cent. more durable than any other typewriter, because it has about 80 per cent. less wearing points than most other typewriters.

Eighty per cent. easier to write with than these other complicated, intricate machines that require "humoring"—technical knowledge—long practice and special skill to operate.

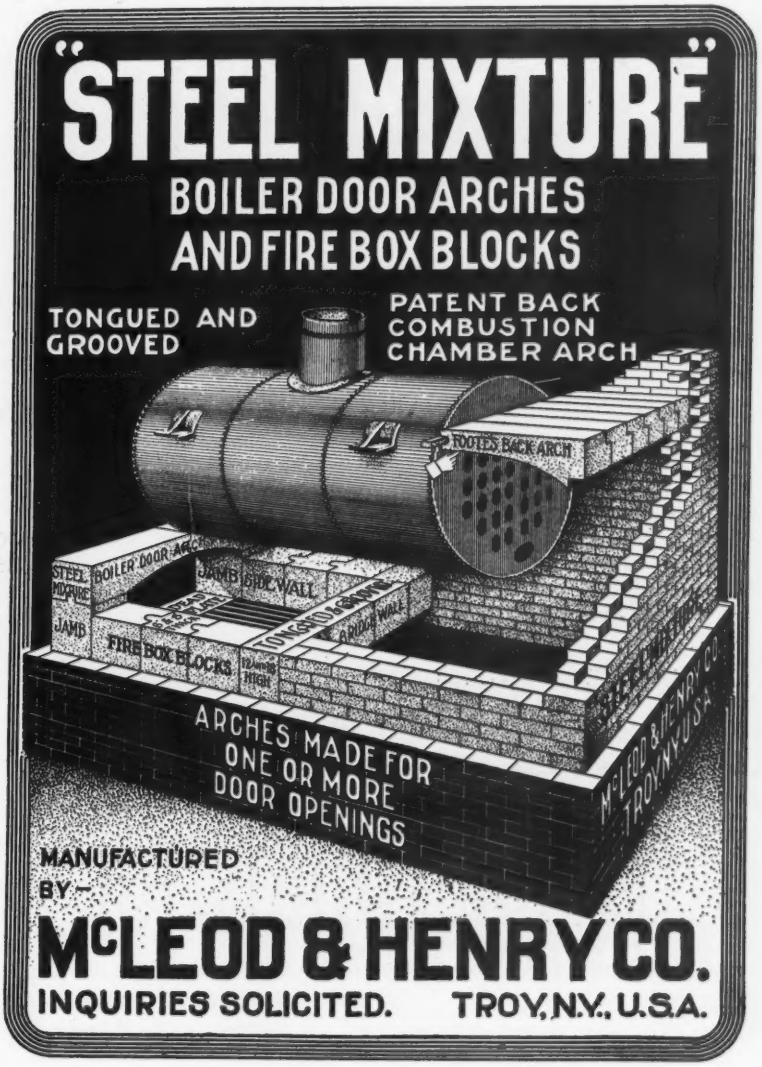
Than machines which cannot be adjusted to any special space—with which it is impossible to write abstracts, insurance policies, or odd-size documents except you buy expensive special attachments requiring experts to operate.

You can adjust the OLIVER to any reasonable space—you can write on any reasonable size and thickness of paper, right out to the very edge, without the aid of any expensive attachment or special skill, and your work will be neat appearing, legible and clear.

For the OLIVER is the typewriter for the doctor, the lawyer, the insurance agent, the merchant, the hotel proprietor—or any man who does his own writing.

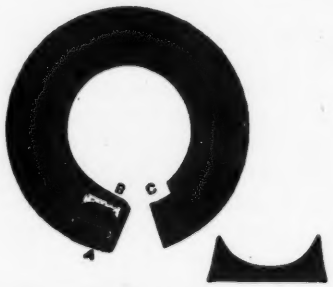
Write us now for our booklet on the simplified features of the OLIVER.

The OLIVER Typewriter Co.
WALNUT AND TENTH STS.
PHILADELPHIA, PA.



BRANCH OFFICE:—
JOHN H. FOOTE, Manager
1402 BROADWAY—ROOM 1125—KNICKERBOCKER BUILDING—NEW YORK CITY

Walsh Metal Face Packing



A—Fibrous Packing. B—Metal.
C—Open space to avoid butting when cover is worn off.
D—Section of metal cut out at C.

Adapted to all kinds of Steam and Water Packing. Will not cut Rods, will not wear rods to shoulder, will not harden under compression. More durable than fibrous packing. Less friction, as it is lubricant of itself. For packing engines, steam hammers, cranes, valves, expansion joints, pumps, elevators, accumulators, hot-water plunger pumps, etc. **Cotton, Linen and Square Flax Packing in Stock.**

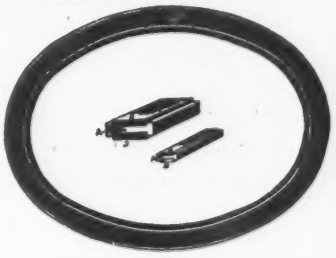
PACKING FOR ELEVATORS a Specialty

Walsh Packing Co.

1118 and 1120 S. Seventh St., Philadelphia, Pa.

Walsh Combination Gaskets

WILL NOT BLOW OUT



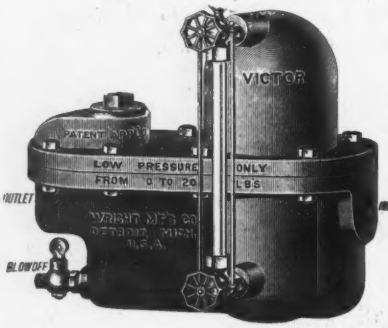
Can be used from 10 to 40 times.
The Cheapest Gasket Made.

A—Soft Metal. BB—Rainbow Rubber. Composed of Soft Metal and Rainbow Rubber as shown in cut. Made different widths and thicknesses for man and hand hole Gaskets.

Wright "Victor" Low Pressure Steam Traps.

For Steam Pressures from 0 to 20 pounds only

Outlet valve approximately as large as connecting pipe, giving greater discharge than by any other trap yet designed. For heating systems and other low-pressure work we guarantee absolute results.
Material first-class, workmanship perfect.



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Our new No. 10 catalogue fully explains our claims and guarantees, and will be sent upon application.

Wright Manufacturing Company
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The Ashton Quality

POP SAFETY VALVES
RELIEF VALVES
BLOW - OFF VALVES
can be trusted at all times, being of a superior quality and guaranteed to give perfect satisfaction.

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STEAM AND VACUUM GAGES
RECORDING GAGES
are absolutely accurate and reliable, having non-corrosive movements.

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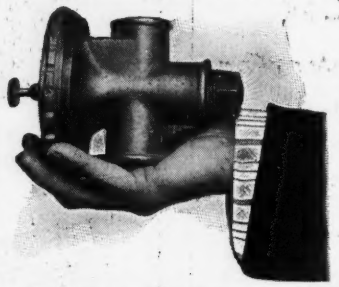
Phosphor-Bronze is the Stuff



that makes the Dunham Trap wear:—Outlasts all others, and the repairs cost less. Made in all sizes and styles either for high pressure, low pressure or vacuum work.
Ask for Circular C.

C. A. Dunham Co.
Marshalltown, Iowa

Resident Manager, L. BANCROFT MELLOR
No. 14 S. Fourth Street, Philadelphia, Pa.

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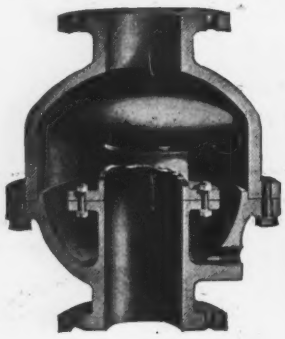
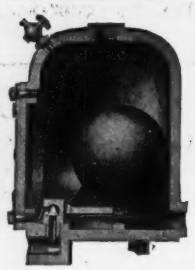


LINDSTROM'S SUPERHEATER STEAM SEPARATOR

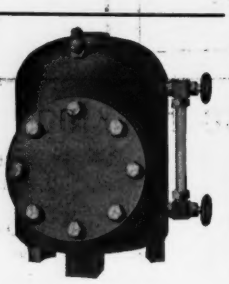
The newest and best made. It removes the Condensation and Superheats the Steam.

Cylinders Rebored in the Present Position from 4 Inches to 80 Inches in Diameter

HIGH GRADE WORK AND A GUARANTEE TO BACK IT UP



LINDSTROM'S CORLISS VALVE STEAM TRAP THAT NEVER FAILS



MY CATALOGUE shows all my specialties in detail and also gives full and complete instructions, with drawings, for setting valves on simple and compound Corliss engines. Free to engineers.

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SEPARATOR FOR INTERIOR OF BOILER.

This Separator will keep the water in your Boiler. It will Reduce the Moisture three-fourths of one per cent. It will stop the priming in your boiler and furnish Dry Steam to your engine. Keep the water in your boiler and save your Engine from break downs.

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Speed Indicator No. 104

Price, Postpaid, $1.00

This Indicator may be run at highest speed required, without heating. The working parts are encased. Dial has two rows of figures, reading either right or left as shaft may run. Steel pointed spindle with rubber tips for both pointed and centered shafts. The O mark may be instantly set at the starting point.

Send for free Catalogue No. 17 N of Fine Tools

THE L. S. STARRETT CO., ATHOL MASS. ,U. S. A.

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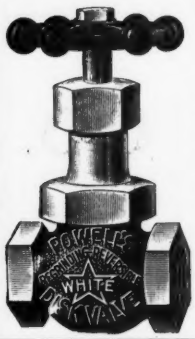

IN SPLENDID GOOD SHAPE

to furnish you with the best Valves in the market for controlling steam and other fluids.

The Powell White Star Valve cannot be equaled anywhere, disk is not only regrinding and reversible but is also renewable decidedly economical because it will outwear three to five other makes.

Surely the Valve is worth your investigation. Send for sample and give it a trial, you will want no other. Jobbers all over the country carry them. Catalogue and booklet fully describes its merits. A post card will bring you a copy. Address

The Wm. Powell Co., Cincinnati, Ohio

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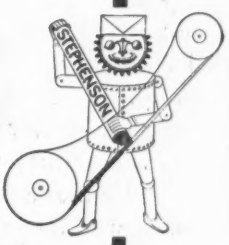
Any Belt Troubles?

Here is the remedy for slipping and decay.

Stephenson Bar Belt Dressing



And see how simple it is

No heating beforehand. Friction does that in the very act of applying **STEPHENSON**

Call on your dealer, or send us 2 Cents for Free Sample, stating if for Leather or Rubber Belts. No ONE kind is good for ALL belts.

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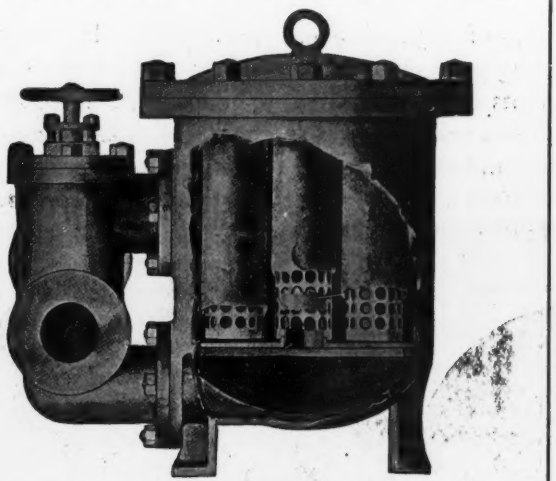
Filtered Feed Water Prevents Scale

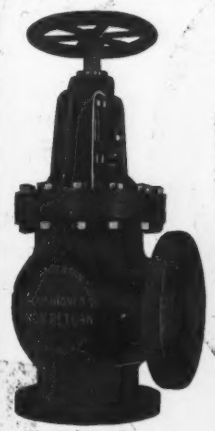


The Blackburn Smith Patent Feed Water Filter and Grease Extractor will remove all the mud and grease from your feed water, prevent scale and save you the cost of boiler compounds and wasted fuel. Can be placed either on the suction or discharge scale of feed pump. Easy to clean. Made in all sizes. Write for Catalogue.

Greacen-Derby Engineering Co.

PERTH AMBOY, NEW JERSEY

"Worth Has Won."



The Anderson Cushioned Non-Return Valve.

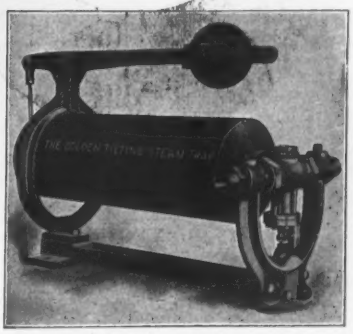
The Anderson Cushioned Non-Return Stop Valve.

"PROTECTS YOUR BOILERS WITH AN ABSOLUTE SAFETY STOP."

Why endanger your boilers by using the regular Angle, Globe or Gate Valves at the boilers, when you can get the ANDERSON Cushioned Non-Return Valve, which is an AUTOMATIC STOP VALVE also a HAND STOP VALVE—All in one.

Possibly we can replace your old valves at the boilers without change of piping.

"We guarantee these valves."



Golden Patent Tilting Steam Trap

THE GOLDEN PATENT TILTING STEAM TRAP

has won for itself an enviable name and reputation. It is a trap of real worth. Simple, positive and durable. It has no floats, valves or buckets inside the trap to cause trouble and expense. All working parts are outside.

We know these traps have no equal

GOLDEN-ANDERSON VALVE SPECIALTY CO.

115 PIKE STREET, PITTSBURG, PA.

GARLOCK OIL PROOF Sheet Packing

This is a splendid high grade, high pressure sheet packing for high pressure steam. It is especially good for pipe flanges effected by vibration. It is unequalled for Gas, Naptha, Benzine, Tar or Syrup, and is positively Oil proof. Makes rough or smooth joints equally well. Perfertly tight when first applied, made in all thicknesses from one thirty-second of an inch up.

We make many other kinds of sheet packing for every kinds of service.

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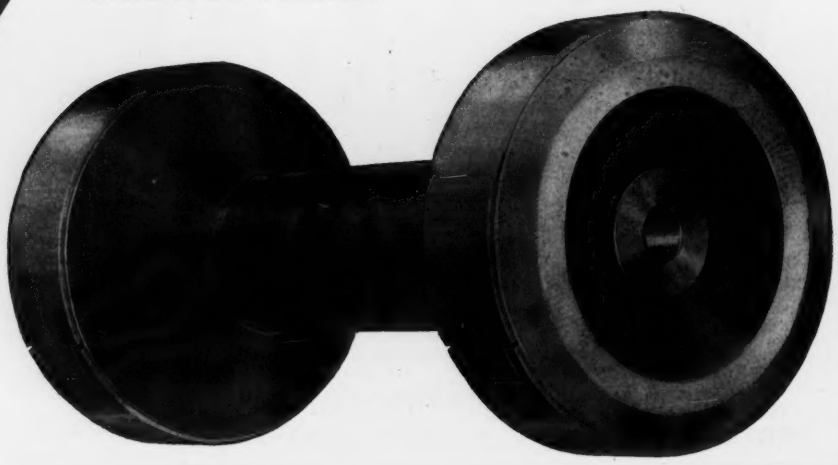
THE

Stayman Piston Valve

is interlocking, self-expanding and steam tight. It consists of simple strong parts; inner spring rings and interlocking bearing sigments which permits it to adapt itself automatically to any uneveness in the valve chest and to take care of the contraction and expansion due to change in temperature.

When you want a Piston Valve get this one, it will save its cost in a few months.



A written guarantee for five years goes with it.

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STAYMAN MFG. CO.
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NEW YORK CITY

When Boilers are scaled, they call for - - -
When Boilers are pitting, they call for - - -
When Boilers are corroding, they call for - -
When Steam Joints leak, they call for - - -
When Boilers prime and foam, they call for -
When Engine Cylinders are hard to lubricate,
too much water in the steam—call for - -

Dearborn
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DEARBORN

Stands for the Scientific Water Treatment, made to suit the analysis of each water sent us.

"DEARBORN" stands for Treatment that does just what you want it to do.

"DEARBORN" stands for the Treatment that is so thoroughly condensed that you are neither buying nor paying freight on water.

"DEARBORN" stands for the Treatment that absolutely cannot be injurious to heaters, feed pump, piping, boilers or steam connections.

The nature of practically all waters necessitates your using something; if you will find out what all others have done, then investigate what this Company is doing, you will without question, adopt DEARBORN WATER TREATMENT in your Boilers as a permanent solution of the problem.

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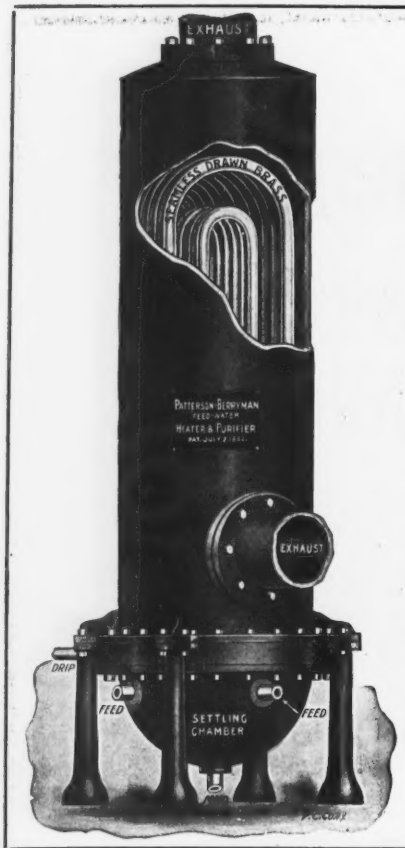

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You can save dollars in operating your power plant, by installing

The Patterson - Berryman Feed Water Heater and Purifier

You can economize still further by using

The Patterson Belt Pump

They will supply your boilers with pure water heated to the highest temperature obtainable by means of exhaust steam, without back pressure.

We are so confident that you will be pleased with the results obtained by the use of these two machines, that we are willing to ship either or both of them to you on trial with the understanding that they may be returned at our expense should they prove unsatisfactory.

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Frank L. Patterson & Co.
24 Cortlandt Street,
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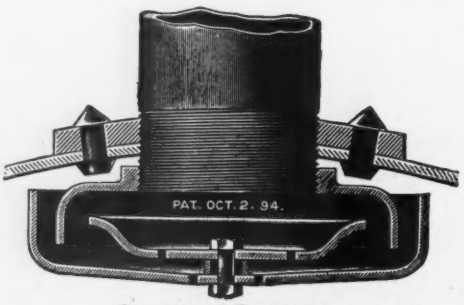
Compound Separators

used in boilers than all others.

They insure dry steam, and protect your engine from water.



Compound Separator

Boiler Fronts, Grate Bars, Furnace Castings, Compound Separators, and General Boiler Castings

The Kutztown Foundry and Machine Co.

WORKS:

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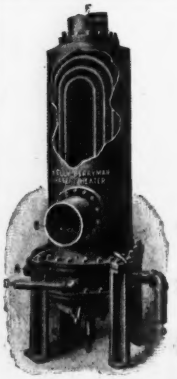
Philadelphia Office: Fidelity Building, Broad above Arch Street.



Berryman

Feed Water Heaters and Purifiers

WATER TUBE AND STEAM TUBE

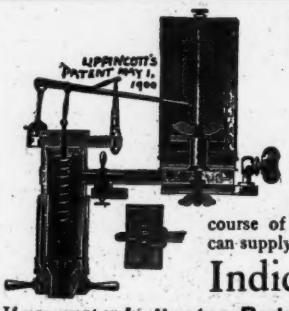
Cast Iron or Steel Shells. "U" Shaped Seamless Drawn Brass Tubes.

We Build Heaters for every Purpose and Condition

THE KELLEY PATENT

Improved Berryman Water Tube, Feed Water Heater and Purifier

BENJ. F. KELLEY & SON, Makers
91 Liberty Street, NEW YORK



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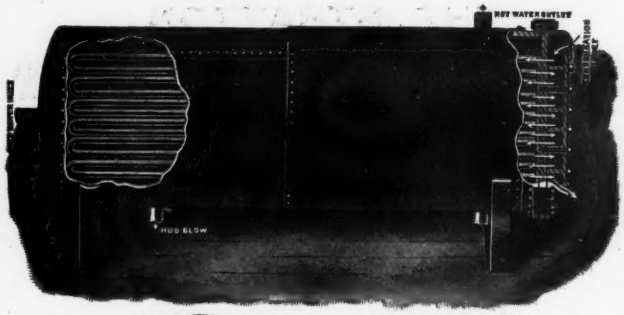
and in connection with the thorough course of instruction which is given by mail, I can supply you with a fine

Indicator Free of all further expense.

If you want an **Indicator, Reducing Wheel or Planimeter,** don't fail to write me and in addition to the fine catalogue, you will receive a neat premium which you will find useful.

Address A. C. LIPPINCOTT, Gen'l. Manager
Green and Columbia Sts. NEWARK, N. J.



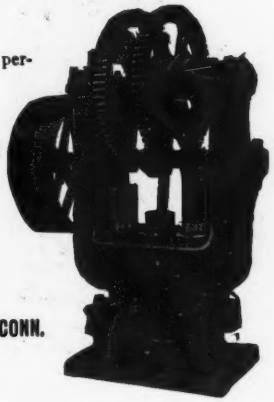
The Gleaner TRADE MARK

The **Gleaner** represents the acme of perfection in feed water heating.

THE

Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.



MANUFACTURERS OF

The "Berryman" Feed Water Heater and Purifier.

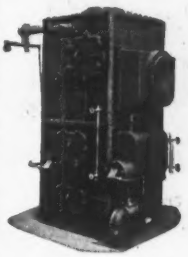
I. B. DAVIS & SON, HARTFORD, CONN.

WRITE FOR CATALOGUE, ETC., TO

THOS. McADOO, 125 N. 4th St., Philadelphia

A Very Practical Way To Save Coal

Thousands of steam users have cut down their coal bills from 5 to 20 per cent by using Cochrane Feed Water Heaters. Over 3,000,000 hp. of these "Cochranes" in present service tell the tale.



Cochrane Heaters have been enthusiastically praised by their users for many good qualities, but first of all they are coal savers, for by utilizing a valuable waste product—exhaust steam—to heat the feed water they decrease the quantity of coal you have to burn under your boilers.

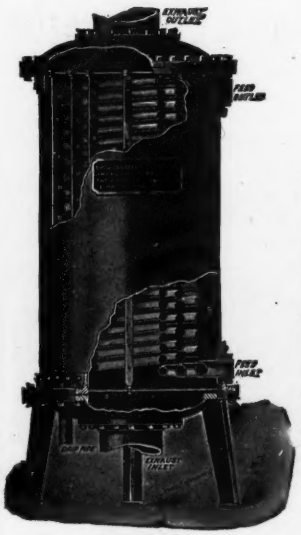
Cochrane Heaters are better coal savers than ordinary feed water heaters because they utilize the exhaust steam more thoroughly. We will give you the proof if you would like to have it. Then besides they are particularly well made.

Even 5 per cent of a coal saving in your plant would be worth while—though probably a Cochrane Heater would save more than that for you. Would you like to investigate these "Cochranes?"

HARRISON SAFETY BOILER WORKS

3144 N. 17th St. PHILADELPHIA, PA.

The American Standard Copper Coil Feed Water Heater



Simplicity!
Strength!
Economy!
A Money Saver!

It gives so little trouble that one of our customers, who has used one for three years, had forgotten that he had it when we asked him the other day how it was doing. He called in the engineer, who said it hadn't been touched since it was put in and was still heating the water to 210 degrees.

THAT.S THE KIND OF A HEATER YOU WANT.

Write for Catalogue No. 100 P

The Whitlock Coil Pipe Co.

HARTFORD · CONNECTICUT

The OTIS

Feed Water Heater, Oil Separator and Purifier is the best oil separator as well as the best feed water heater made. When you buy an Otis you buy satisfaction or you get your money back! and we pay the freight and cartage both ways.

The arrangement of the tubes; the water and oil separator and the cool settling chamber are features that will be appreciated at once by every experienced engineer.

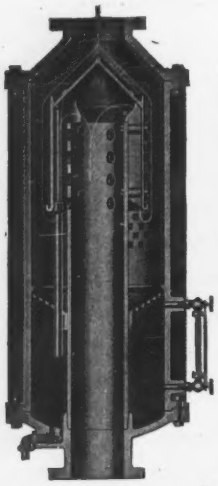
The location of the connections; the "travel" of the exhaust and the ease with which it can be cleaned are features of equal importance.

We Guarantee to heat the feed water to the boiling point (210 or 212 degrees) with the exhaust without causing any back pressure, also to extract the oil from the exhaust

WRITE FOR CATALOGUE

The Stewart Heater Co.

11 Norfolk Avenue BUFFALO, N. Y.



Sweet's Separators

When considering the Separator subject, please let us send our catalog and blue prints; look up the dimensions, weights and proved efficiencies of our machine, compare them with others and see if we don't furnish the most for the money; then consider the **plan** and **finish** of our separators; see if the plan is such that **you think** it will give the results claimed. Made in all styles, for steam or oil.

SEND FOR CATALOG. ALL STYLES.

Direct Separator Co.

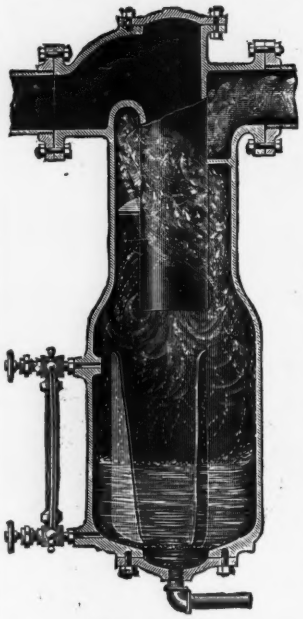
220 Marcellus Street

Syracuse : : New York

SALES AGENT

A. D. HEYL, 42 North 16th Street, Philadelphia, Pa.

THE STRATTON Steam Separator



Will deliver **Dry Steam** to your engine under any and all conditions, no matter how long your steam pipe or how much your boilers may prime.

Separation takes place by the action of centrifugal force imparted to the steam. The large capacity not only provides for a sudden influx of water but forms a reservoir of steam which equalizes the pressure between boiler and engine, thereby increases the power and stops the vibration of steam pipes; a separator of small capacity is worse than useless, it is harmful.

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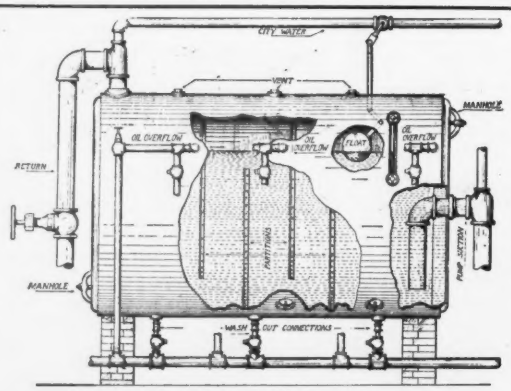
The Goubert Mfg. Co.

85 Liberty Street, NEW YORK

WORKS BAYONNE, N. J.



PATENTED JAN. 10. 1905

Your Heating System

may have developed some defects during the past winter, perhaps its efficiency was not as high as you desired on those few coldest days, or perhaps you have discovered that you are blowing a lot of water, oil and heat out into the sewer.

THE McKNIGHT RECEIVER AND OIL SEPARATOR

will receive all the discharge from your steam traps and all the condensation from your entire heating system and will separate all oil and grease from the water so that both the water and the oil is purified and can be used over again. Its use will improve the entire system and save many times its cost. Write for Circular and Prices.

Walter J. McKnight, 179 WASHINGTON ST. BUFFALO, N. Y.

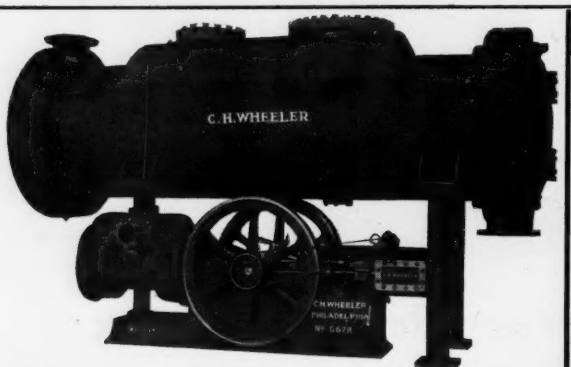
WHEELER-MULLAN

HIGH VACUUM APPARATUS

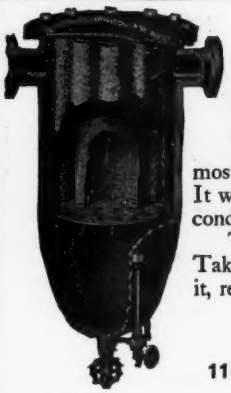
C. H. WHEELER Improved Surface Condenser with Mullan Suction Valveless Air Pump.

C. H. Wheeler MANUFACTURING **Co.**

PHILADELPHIA



26 Cortlandt St. NEW YORK | 151 Tremont St. SAN FRANCISCO | 184 Washington St. CHICAGO



The Acton Steam Separator and Oil Extractor

This Separator represents the latest and most valuable improvements yet discovered. It will take out 95 per cent. of the oil and condensation.

The only Separator that can be cleaned. Take off the top, remove the basket, clean it, replace it and you have a new Separator.

WRITE ME.

JOHN ACTON

118 John St., Brooklyn, N. Y.

The Baum Separator

For Live and Exhaust Steam
RESULTS GUARANTEED

Repeat orders are the best evidence of satisfactory results on the part of a satisfied customer.

"We are using the second Baum Separator and are very much pleased with the results we are getting from it," writes one who has been using Baum Separators for several years.

Write for further information before placing order. A new catalog on request.

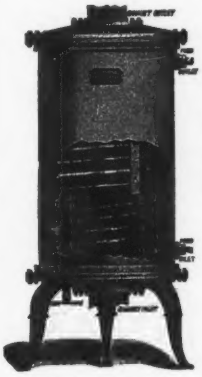
Horizontal Style for live Steam or Oil Service.

Vacuum Style Oil Extractor.

The Baum Separator and Machine Co., MANHEIM, PA.

The National Feed-Water Heater

2,500,000 Horse Power in Daily Use



The National

The principal characteristics of these heaters are *Simplicity, Cheapness, Reliability and Effectiveness,* and full amount of heating surface in every heater.

Supplies Water to the Boiler at 212° F.

We manufacture the Original and Only Genuine First-Class Coil Feed-Water Heaters.

We Also Manufacture All Kinds of Coils in Iron, Brass and Copper Pipe

Catalogue and Prices on Application.

Manufactured and Sold Only by

THE NATIONAL PIPE-BENDING CO.

157 Lloyd St. NEW HAVEN CONN.

THE GEMMEL PATENT BOILER

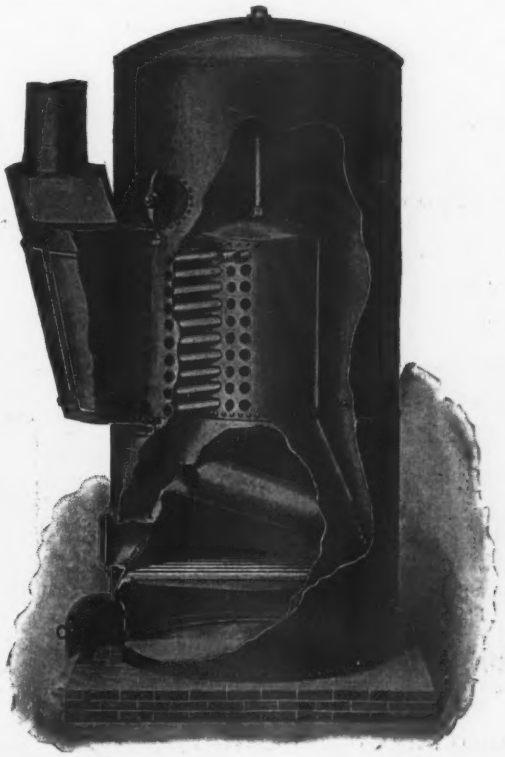
JAMES GEMMEL

Phones:—Bell, Market, 11-73 D Keystone, Main, 46-91 D

This Vertical Boiler possesses all the advantages of a Horizontal Boiler and none of its expensive disadvantages.

It requires only small floor space. It requires no expensive setting. It affords a natural path for the flue gases, and is a rapid steamer.

Its improved construction guarantees rapid circulation, and the highest degree of efficiency.



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General Engineering Co.

764 Swanson St., Philadelphia, Pa.

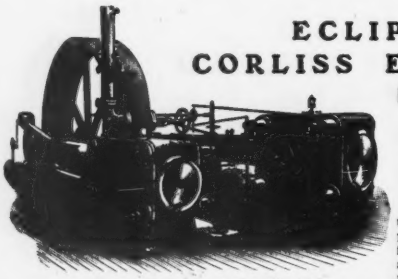
ENGINEERS. BOILER MAKERS.
MACHINE BLACKSMITHING.

Machinery Repairs—Cylinders of Engines and Pumps Rebored in place. Stacks, Tanks and all kinds of Boiler Work.

FRICK COMPANY

ENGINEERS

WAYNESBORO, FRANKLIN CO., PA.

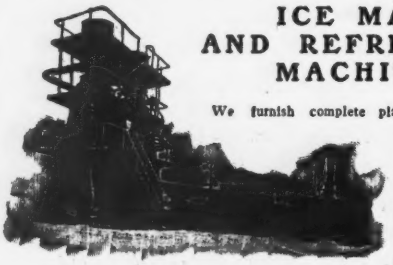


ECLIPSE CORLISS ENGINES

Plain Corliss Engines, Cross and Tandem Compound, Vertical Corliss Engines.

Corliss Engines of any type, 40 to 2000 horse power, specially adapted for electric railway work and lighting for factories, mills and general work.

Best regulation and economy guaranteed. Also builders of Steam Boilers. We solicit the furnishing of steam plants complete, including everything. Send for our CORLISS ENGINE PAMPHLET and list of references.



ICE MAKING AND REFRIGERATING MACHINERY

We furnish complete plants for ice-making and refrigeration for Breweries, Packing Houses, Cold Storage, etc. All refrigerating capacities from 2 to 300 tons; ice-making plants from 1 to 1000 tons per day. We publish a book describing Ice-Making and Refrigeration, which will be sent to intending purchasers.

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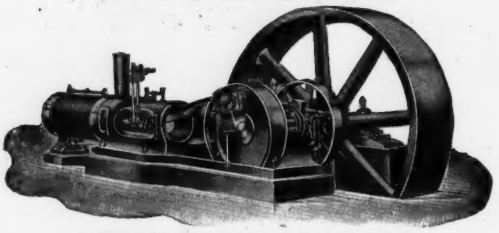
BUCKEYE ENGINE Co.

SALEM, OHIO, U.S.A.



STEAM ENGINE BUILDERS.

THE LARGEST LINE OF MODERN ENGINE PATTERNS IN THE WORLD.

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DAVIDSON PUMPS

"THE BEST PUMP BUILT"

FOR ALL SERVICES

Finest Mechanical Design and Construction

Material and Workmanship first class in every respect.

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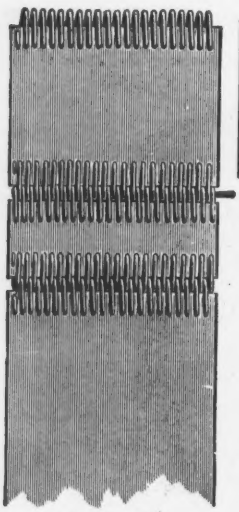
Boston Office:—30 Oliver Street



Look at that Lacing a minute—isn't that well done?

Well you can lace a 5-inch belt this way in less than 3 minutes at a cost of one cent for the lacing if you'll get a

Jackson Belt Lacer

AND MIND YOU—

This joint is just as 'pliable as any other part of the belt.

The shortening or lengthening of a belt when laced in this manner is but the work of a few seconds.

Think this over and write—

Birdsboro Steel Foundry and Machine Co.

BIRDSBORO, PENNA.

GET ONE FREE

Put it on your boiler, and give it a good trial for a month; if it gives you absolute satisfaction, keep it, and pay for it, otherwise send it back at our expense.

"P. B. H." WEIGHT GAUGE COCK

There is but ONE renewable part; the special metal valve pencil, which lasts for years and can be replaced for a few cents, in a minutes time. Thousands in use. Absolute satisfaction on high pressures.

THE PAUL B. HUYETTE CO., Inc. 1245 BETZ BUILDING PHILADELPHIA

ELEVATOR REPAIRS

YOU HAVE ELEVATOR TROUBLES. WE HAVE EXPERIENCE. LET'S SWAP.

Keystone Elevator Inspection & Repair Co.

923 LOCUST STREET, PHILADELPHIA

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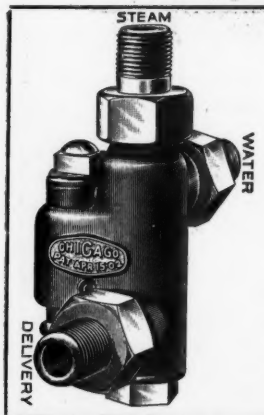
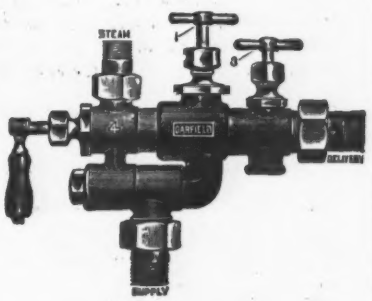


Chicago AND Garfield

INJECTORS are today made as strong, heavy and with as much care as when metals were low. You are taking no chances when your boilers are equipped with them.

A user of our Injectors of Wanakena, N. Y., writes that he has used one of them for sixteen years and it is still giving satisfaction. This shows how well they are made.

We have a complete line of Injectors, Ejectors, Lubricators, etc., for stationary and locomotive service. Ask your dealer for them.



CATALOGUE FREE

The Ohio Injector Co.

2128 MAIN STREET WADSWORTH, OHIO

U.S. Automatic Injector

See that Drip Cock?

It is a distinctive feature of the U. S. Automatic Injector, and has these special and exclusive advantages:—

1—It drains the Injector when not in use, and thus prevents freezing.

2—By leaving it open you can start Injector even though the check-valve leaks. This is impossible without the Drip-Cock.

3—By opening Drip-Cock you can start with lower steam.

4—By leaving it open, when not in use, it prevents suction of pipe from getting hot, or jet from "liming up" when steam or check-valve leaks.

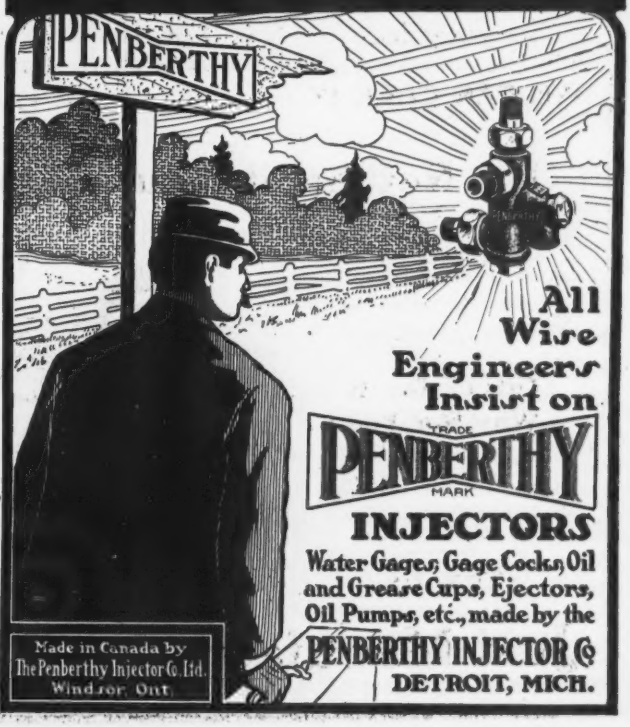
5—It enables you to take hot water out of a hot suction pipe on a long lift.

6—It is always handy for drawing hot water for any purpose when injector is working.

Write for the **Engineer's Red Book.** You need it and we will send it free on request.

American Injector Co. DETROIT, U. S. A.

FOLLOW THE ROAD TO SUCCESS!



All Wise Engineers Insist on

TRADE PENBERTHY MARK

INJECTORS

Water Gages, Gage Cocks, Oil and Grease Cups, Ejectors, Oil Pumps, etc., made by the

PENBERTHY INJECTOR Co

DETROIT, MICH.

Made in Canada by The Penberthy Injector Co. Ltd. Windsor, Ont.

FREE

To prove to your satisfaction that we have the most economical up-to-date Metallic Packing, send us your full name and address, by whom employed, number of engines and total horse power, and we will send you for trial, free of all charges, a sample can of

Ambest

TRADE MARK

"Ambest" is put up in 1, 2, 5, 10, and 25-lb. cans.

The new and better Metallic Packing; The most perfect Metallic Packing in every way yet produced; No rings or springs. Absolutely frictionless; Simplest and most practical; No waste; Stands highest pressure and speed. Its great special feature and which distinguishes it from all other Metallic Packings, is it adaptability to any stuffing box, or any place, (large or small) where any kind of packing is needed, and all can be packed from the same can:—The smallest steam valve or the largest piston rod. Hot and Cold Water, Ammonia, Brine, Oil and steam,—equally good for all.

SEND FOR FREE SAMPLE AT ONCE. DON'T WAIT.

CANFIELD MFG. CO., Ltd.

SOLE MANUFACTURERS

116 West Lehigh Avenue, PHILADELPHIA, PA.

Beware of Imitations. Ask for the Genuine "AMBEST" and see that it bears our Trade Mark as above

We Have Established Sole Agencies with the Following Firms:—

Sunderland Roofing & Supply Co., Omaha, Neb.
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Tatum & Bowen, San Francisco, Cal.
W. H. Salisbury & Co., Chicago, Ill.
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Do you have a **Brown Core** in your Ice?

WE CAN CURE IT

100 Ice Plants

Use The Just Mechanical Boiler Cleaner
We will show you Why at our expense
Send for Descriptive Matter

Do you have **Scale** in your Boiler?

WE CAN CURE IT

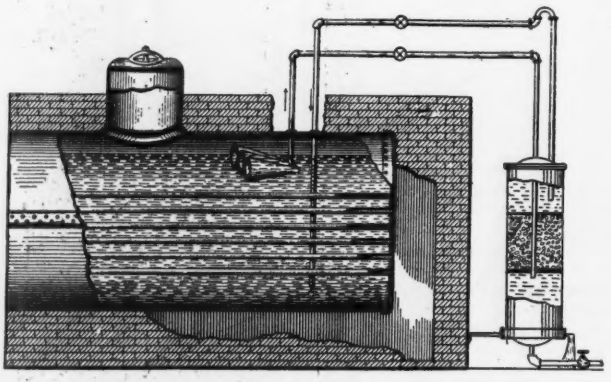
Do Not Spoil Your Output With Boiler Compound

We guarantee that you can run an entire season without shut down to clean boilers when the Just Cleaner is used.

Others Do It
Why Not You

No trouble.
No yearly compound bills.
No burnt tubes or sheets.

TRY US



The Just Mechanical Boiler Cleaner will clean your boilers of scale, will clean your ice of discoloration and

Bad Taste

and will keep right on doing it as long as your plant is in operation.

Give Us a Chance To Prove It

Just Manufacturing Company,

1215 FILBERT STREET, PHILADELPHIA, PA.

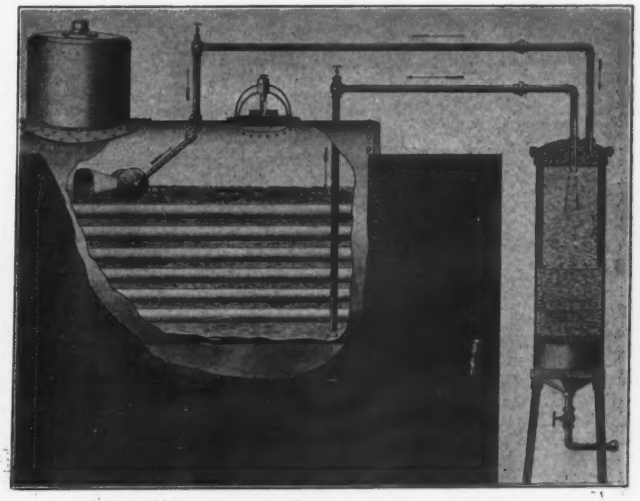
WHAT DO **YOU** THINK ABOUT IT.

Some engineers think that it is not possible to remove the scale forming matter and other impurities from boiler feed water mechanically while the boiler is under pressure. Other engineers with a knowledge of chemistry think that it can be done, while still other engineers with actual practical experience **know** that it can be done and is being done in hundreds of boilers every day in the year by

The Buckeye Automatic Boiler Skimmer

Notice the cut, it is the only Automatic Skimmer. It follows the water level automatically and is always working to its full capacity; it removes all impurities from the water and deposits them in the filter from which they are blown off at will. No more chemicals. No more boring machines. No more labor. No cost except first cost. Try it, free. Proof or no pay that's our way.

SHALL WE SEND OUR CATALOGUE



Works equally well on any type of boiler. Notice the floating skimmer. No other cleaner has it.

BUCKEYE BOILER SKIMMER CO. Colburn Avenue, TOLEDO, OHIO

Did It Ever Occur To You Why

Nonpareil Cork

For Pipe Covering or Cold Storage Insulation is so much more efficient than other Materials.

It contains no foreign bind, such as pitch, asphalt and shellac, which reduces the efficiency.

In "NONPAREIL" the NATURAL GUM OF THE CORK only is the binder.

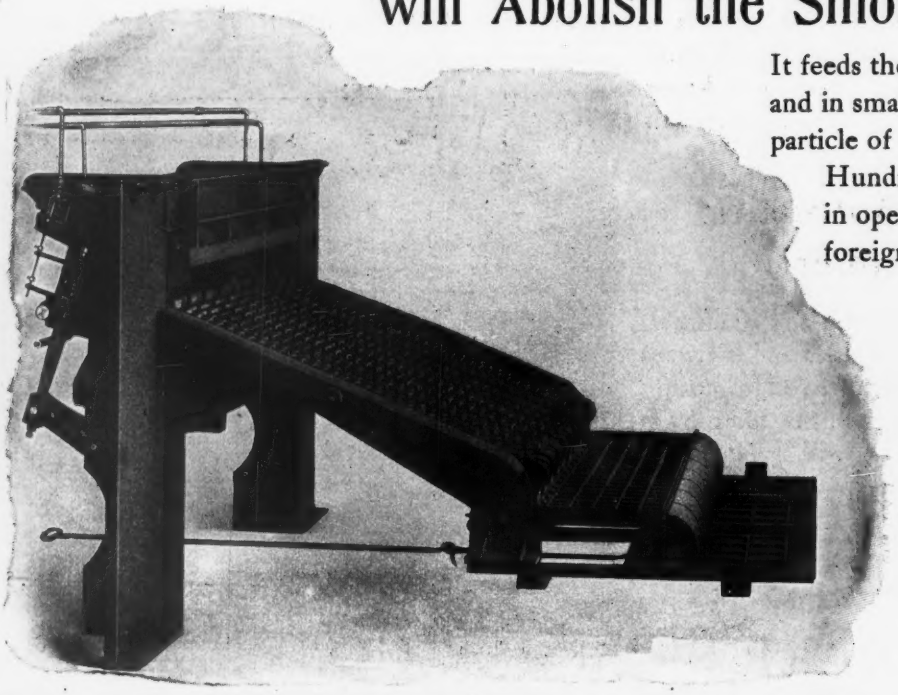
JOHN R. LIVEZEY
1936 Sansom Street
PHILADELPHIA, PA.

Nonpareil Cork Works
105 Hudson Street NEW YORK

JOHN R. LIVEZEY
612 E. St., N. W. Washington, D.C.
L. P. MENCHINE, Mgr.

The Wilkinson Automatic Stoker

will Abolish the Smoke Nuisance

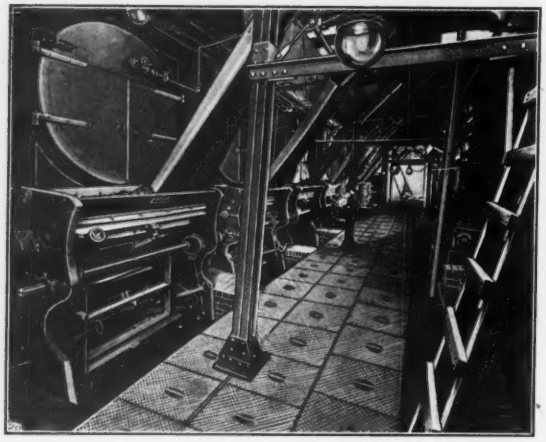


It feeds the fuel automatically, constantly and in small quantities as required; every particle of the fuel is burned.

Hundreds of Wilkinson Stokers are in operation in all parts of this and foreign countries, all of which are producing highly satisfactory results. If you have never investigated the advantages of this splendid and highly efficient Stoker write us for Catalogue and full information.

WILKINSON MFG. CO.
BRIDGEPORT
Montgomery County, Pa.

AN UP-TO-DATE PLANT



No steam plant is up-to-date until it is equipped with Mechanical Stokers. Hand firing at its best is wasteful, and the frequent cold drafts when the fire doors open are injurious to the boilers.

WETZEL MECHANICAL STOKERS

save their cost quickly and pay big interest on the investment, They eliminate black smoke and produce uniform power at greatly reduced cost.

WRITE FOR CATALOGUE AND COMPLETE INFORMATION

The Wetzel Mechanical Stoker Co.
147 East State Street, TRENTON, N. J.

FREE To Any Engineer

A TABOR CROSBY OR AMERICAN-THOMPSON **INDICATOR**

Also 500 other things including every article, tool or device an engineer may want. For Free premium list and full particulars regarding this remarkable offer, fill out and mail us the coupon below.

FRANCE PACKING CO., Inc.
State Road, Tacony, Philadelphia
MANUFACTURERS OF
METALLIC, FIBROUS AND SHEET PACKINGS

Tear OFF Here

Date,_____1904.

FRANCE PACKING CO.,
State Rd., Tacony, Philad'a.

Gentlemen:

Kindly send me premium list and full particulars regarding the indicators and other articles you are giving to engineers.

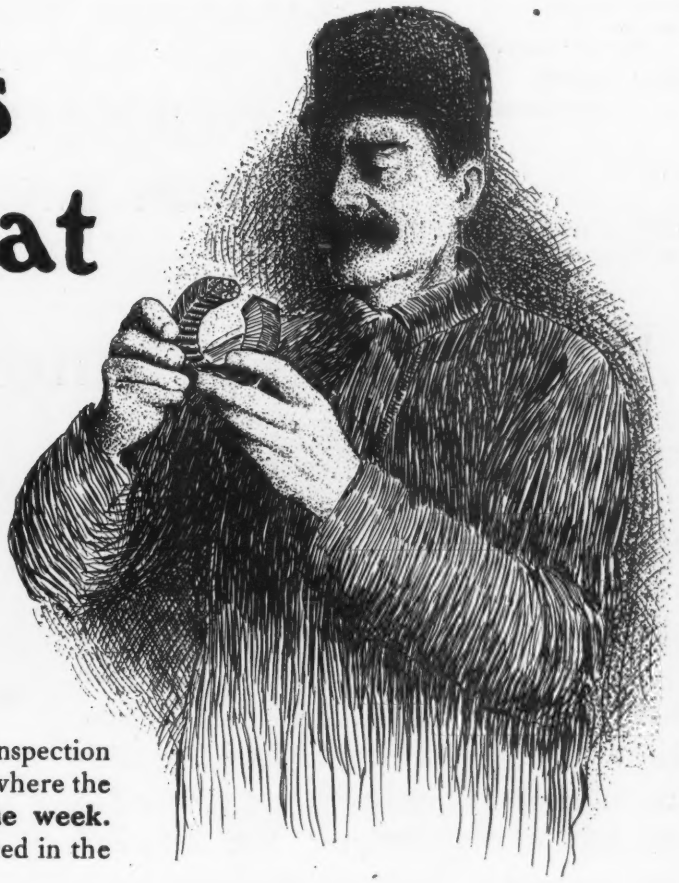
My name is_____

My address is_____

I am employed by_____

Give Complete Address.

Here is Proof that P. P. P. has long Life!



This ring of P. P. P. was removed for inspection after being used for over **six months** where the best ordinary packings wore out in **one week.** Being in excellent condition it was replaced in the stuffing box. In this instance

P. P. P. Rod Packing

was worth at least twenty-six times the best ordinary packing—for it had lasted twenty-six times as long! And it worked well too—the ring shows how P. P. P. sets itself to the grooves of a worn or scored rod, making it steam-tight.

You would jump for joy if we made your engine run without any packing whatever—the pleasure of being free from all packing troubles and expenses would certaintly be great. Well the peaceful way P. P. P. works generally makes you forget there is a stuffing box—it's like being able to run your engine without packing. For months and months you may not have to look at the stuffing box. Even when P. P. P. does show signs of wear, an extra ring will make it work like new. **With P. P. P. all stuffing box troubles are practically wiped out.**

We want **you**—we want **every engineer** who fails to get satisfaction from the packing he uses—to read our booklet on P. P. P. It throws a new light on Rod Packings.

You'll learn something from this booklet—something you'll be glad to know. And you can't know it too soon—send for the P. P. P. Booklet **now.** Dept. "E"

NOTE— The success of P. P. P. has brought out many worthless imitations. Protect yourself by **insisting on P.P.P., the original and only genuine self-setting packing.**

Quaker City Rubber Co.

PHILADELPHIA, PA.

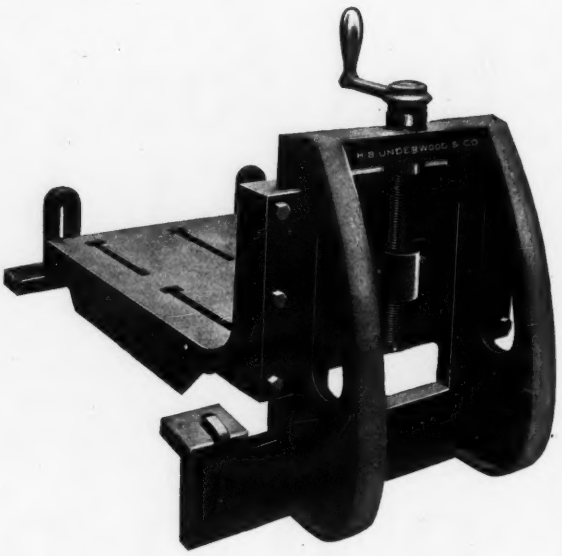
DANIEL W PEDRICK.
MORRIS G. CONDON
ALBERT D PEDRICK
EDWIN J. ROOKSBY
Superintendent

L. B. FLANDERS MACHINE WORKS.
ESTABLISHED 1870

Sole Makers of
ST. JOHN SELF ADJUSTING
CYLINDER PACKING.

H. B. UNDERWOOD & CO.
GENERAL MACHINISTS,
1025 HAMILTON STREET PHILADELPHIA, PA.

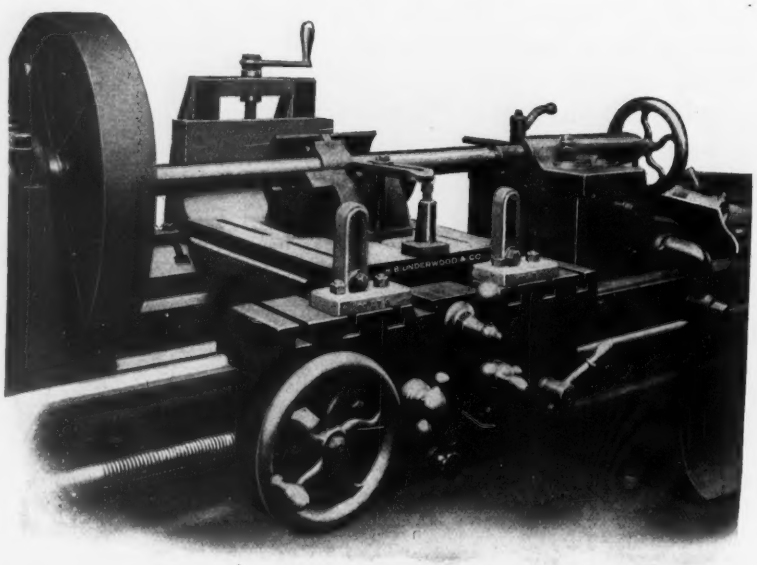
Boring Attachment For Lathe



THIS attachment is for the purpose of practically converting a lathe into a horizontal boring mill, and when so converted the lathe is equal within its range the output of a mill both in quality and quantity. The attachment which we here illustrate can be made for any size lathe. It consists of a lower plate with an angle projecting down and fastened to the back of the carriage. The surface of this angle plate is planed true with all the other parts of the attachment. The fastening device has a slide well fitted and planed true; it also has an adjusting screw for elevating the bed for holding the work.

When set on the lathe carriage, it is true with the carriage in all directions.

It takes a very short time to make the change for boring; all that is necessary is to remove the tool slide, and drill and tap two holes in the back of the carriage, lift the device on, and in a few minutes it is ready for work.



LATHE WITH ATTACHMENT IN SERVICE

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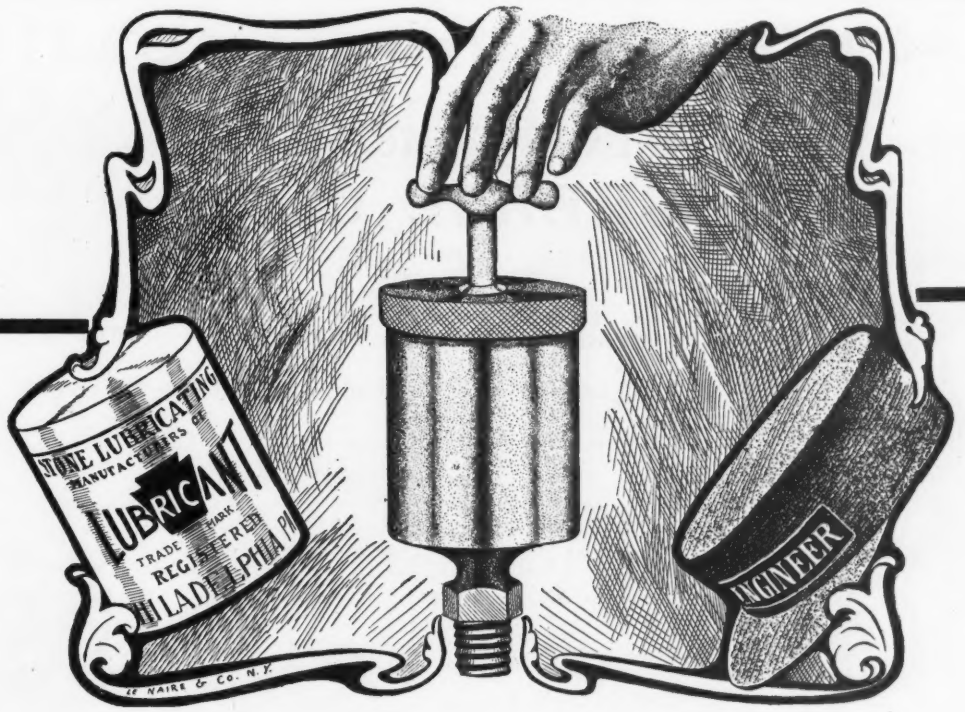

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If you were to examine a bearing on which Keystone Grease was used, you would find it to have a mirror like smoothness that tells a tale of speed, smooth running, non-heating, far better than words can convey.

KEYSTONE GREASE makes a tremendous difference in the wear of a bearing. It is the one lubricant that possesses lasting qualities. No matter how close fitting the bearing may be, how slow moving or fast running, Keystone Grease will form a perfect film that prevents friction better than any oil, grease or lubricating compound made to-day; and furthermore, one pound of Keystone Grease will do more and last longer than 3 to 4 pounds of any other grease, or 4 to 6 gallons of high-grade oil.

We send FREE, a large Sample Can, a Heavy Brass Grease Cup, and an Engineers Cap to any engineer sending us his name and business address, M. E. P. and H. P. of engine and size of tap in which cup is to be used. No strings tied to this offer, it is absolutely free.

Keystone Lubricating Co.

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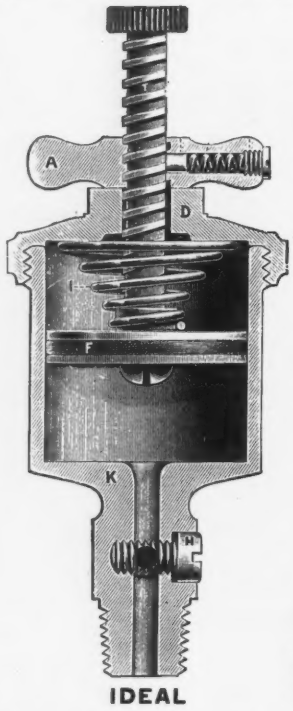

IDEAL

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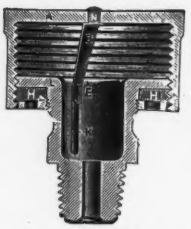
GREASE CUPS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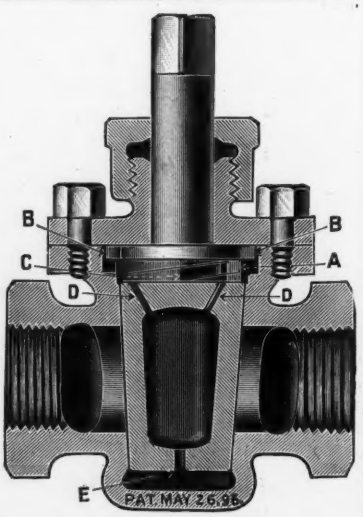
have been used for years in the immense steel mills of Pittsburg and vicinity where the water is notoriously bad and where the boiler pressures average higher than in any other district in the world. They have stood up under the worst conditions, have lasted longer and given less trouble than any other valve made. They are also in use in thousands of other plants all over the world and we believe they would be in use in your plant if you just knew how serviceable they are and how much trouble they would save you.



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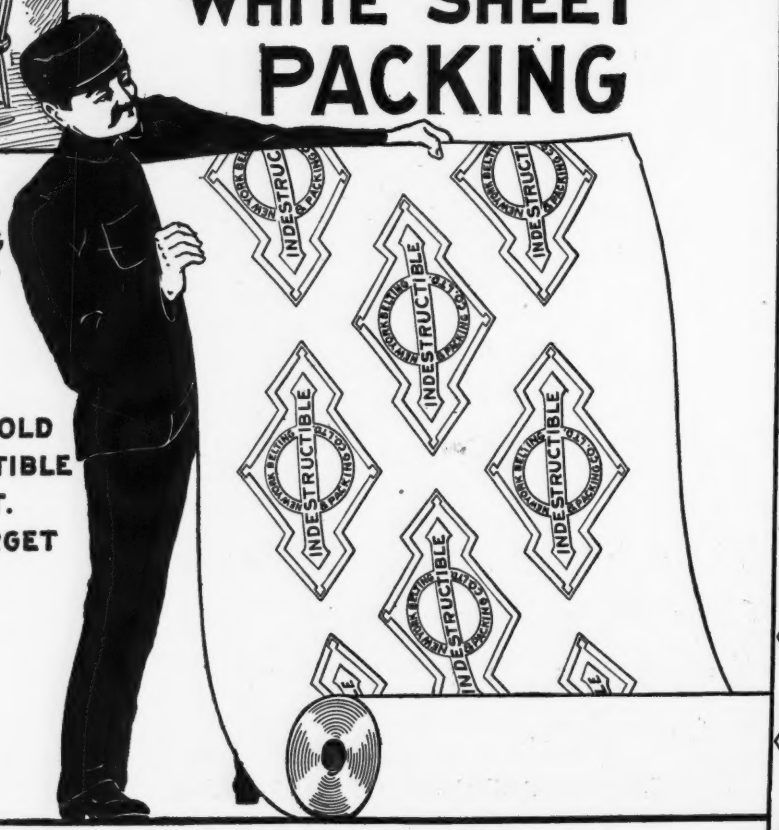

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